LAPTOP GSM System

User Manual

TLC SOLUTIONS INC.

SUITCASE GSM USER MANUAL
(SEPARATE COMPONENT PACKAGE)
UPDATED SEPTEMBER 9, 2009

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Preface

General Information
The information in this document describes the connectivity and deployment of TLC Solutions' Laptop GSM (LTGSM) System (Separate Components).

Intended Users of this Guide
This guide is intended to be read by individuals responsible for the deployment and use of the LTGSM System. It is assumed that the reader has a basic knowledge of Global Systems for Mobile Communications (GSM) technology.

Conventions Used in this Guide

WARNING – Alerts the reader to a situation that might affect personal safety.

CAUTION – Alerts the reader to a situation that might affect the integrity of equipment, software or data.

NOTE – Provides the reader with important or supporting information.

STOP – Informs the reader that a procedure is finished.

Guide Organization

The guide is organized as follows:

Section 1, "The TLC Laptop GSM System", describes the subsystem and its characteristics and provides a list of items provided with the package.

Section 2, “Installation”, covers the procedures to unpack and install the equipment.

Section 3, “System Configuration”, provides current system information as well as screenshots and configuration commands for the MSC, BSC and BTS.

Section 4, “Upgrades to the MSC and BSC”, provides instructions for LTGSM upgrades.

Section 5, “Periodic Maintenance”, describes the procedures that should be performed periodically to ensure the LTGSM operates properly.

Section 6, “Technical Support”, provides information to obtain additional technical assistance, if required.

Appendix A, “Acronyms”, provides a list of acronyms used in this manual.

Appendix B, “Quick Installation Guide”, provides step by step procedures on installing the LTGSM.

Appendix C, “Configuration Guide”, provides information on the Web Browser interface and how to proper administer the LTGSM

Appendix D, “I/O Connector Pinouts”, provides pinouts for all external connectors on the LTGSM.

Appendix E, “dBm to Watts Conversion Table”, provides a dBm to Watts conversion table.

Appendix F, “ARFCN Frequencies”, provides the ARFCN frequencies for the 850, 900, 1800, and 1900 MHz frequency bands.

Safety Precautions

The following general safety precautions must be observed during all phases of system installation, service, and repair of this equipment. Failure to comply with these precautions or specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of this equipment. TLC Solutions, Inc. assumes no liability for the customer's failure to comply with these requirements.
The safety precautions listed below represent warnings of certain dangers that TLC Solutions, Inc. is aware of. As the user of the product, you should follow these warnings for the safe operation of the equipment in your operating environment.

Read this Guide Thoroughly

CAUTION - The technician must be completely familiar with the procedures contained in this document before beginning the actual installation.

Complete all Steps

CAUTION - The technician must perform each procedure in its entirety.

Ground the Equipment

WARNING - To minimize shock hazard, the equipment should be connected to a properly grounded electrical outlet.

Only Qualified Personnel Should Service the Equipment

WARNING - Only trained personnel may remove equipment covers to install and service the internal assemblies of the LTGSM. The LTGSM contains high-energy equipment that can cause injury or death. Under certain conditions, dangerous voltages and/or currents may exist even with the power supply removed.

Do Not Service or Adjust Alone

WARNING - Do not attempt internal service or adjustment unless another person capable of rendering first aid and resuscitation is present. Dangerous voltages and/or currents, capable of causing injury or death, are present in this equipment.

Do Not Operate in an Explosive Atmosphere

WARNING - Do not operate the equipment in the presence of flammable gases or fumes. Operation of electrical equipment in such an environment creates a definite safety hazard.

Do Not Substitute Parts or Modify Equipment

WARNING - Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of equipment.

TLC's Laptop GSM System

The LTGSM System is a complete GSM system in a suitcase. The package contains a MSC, GSN*, SMSC, AUC*, MMSC*, BSC and BTS. This system is capable of providing Voice, Circuit Switched Data (CSD) and High Speed Data. Due to the system type, the area of coverage is limited to 500 feet indoors and approximately 100 yards outdoors depending on the environment. Larger footprints can be achieved with the addition of TLC's Range Enhancement Pack (REP) and external antennas.

The main features of the LTGSM System are as follows:

- Single Chassis MSC, BSC, GSN*, AUC* and SMSC with single PCI slot for external voice connectivity
- External connectivity is achieved via a SIP interface
- Single Carrier BTS with internal antenna (up to 20 supported)
- Small package consisting of all communications equipment and power equipment

Note: * Indicates a non-standard feature and the purchase of a separate software license is required.

Single Chassis MSC, BSC, GSN, and SMSC

A single Laptop computer running Windows XP with Linux Redhat on a virtual machine is used to support the MSC, BSC, GSN, AUC and SMSC functionality of the network. While this is a very small package it is capable of supporting up to 20 single carrier BTSs.

External Connectivity

External connectivity is achieved with a single Ethernet interface. Both administration as well as voice traffic is carried over this interface.

Single Carrier BTS

The single carrier BTS is offered in all four (4) standard GSM Bands. As with most single carrier base stations this one offers 8 total timeslots (7 usable + 1 control). Voice, CSD and General Packet Radio Service (GPRS) are supported. The LTGSM can support up to 20 single carrier BTSs.

CAUTION – The single carrier BTS used in the LTGSM system was designed as an indoor base station. As such, the receiver on the BTS is not as efficient as those found in commercial grade outdoor base stations. This means that the LTGSM system will be more susceptible to interference and may not provide a balanced link to and from the GSM handset. TLC has taken steps to resolve some of the complications associated with the BTS, but can not guarantee optimal service during its use.

Note

Note – The standard GSM bands are 850 MHz, 900 MHz, 1800 MHz and 1900 MHz.

Small Portable Packaging

The packaging is system dependant, but in most situations the major components are in a single suitcase with additional base stations and peripheral equipment packaged in additional cases. The typical packaging is as follows:

- Laptop PC consisting of the MSC, BSC, GSN, AUC and SMSC with associated voice connectivity module (if any)
- USB Security Dongle for the MSC/BSC software
- Power Supply and cord for the Laptop
- Single Carrier BTS
- Range Enhancement Package
- One (1) Straight Through Ethernet cable
- One (1) Crossover Ethernet cable
- Two (2) standard AC power cords

If there are additional BTSs they will be supplied in a separate case so that they may be deployed separately from the main set-up. The separate case will normally include the following:

- Single Carrier BTS
- Range Enhancement Package
- One (1) Straight Through Ethernet cable
- One (1) Crossover Ethernet cable
- Two (2) standard AC power cord

System Installation

Completely read and understand this entire section as well as Appendix B of this document before deploying and operating the LTGSM.

There are several ways to deploy the LTGSM. It may be deployed as a single carrier system with no external connectivity or there could be multiple carriers connected across the world via the internet using technology such as VPN connectivity. The following sections will provide the user with instructions on how to unpack and connect the system for the best results. The following scenarios will be covered:

- Unpacking the system
- Deploying the system ***without*** the use of an Ethernet HUB or Switch
- Deploying the system ***with*** the use of an Ethernet HUB or Switch
- Connecting a second BTS to the system
- Connecting to a Range Enhancement Package

Unpacking the System

1. Ensure that there is adequate space to operate the system.
2. Remove all equipment from the foam case.
3. Inventory the equipment in accordance with the packing slip.
4. Ensure that none of the components are damaged.
5. Proceed to system installation.

Caution

CAUTION – Do not operate the system while it is still in the foam. Doing so could damage components due to overheating.

Deploying the system '*without*' the use of an Ethernet HUB or Switch

See section 1 of the Quick Installation Guide in Appendix B of this document.

Deploying the system '*with*' the use of an Ethernet HUB or Switch

See section 2 of the Quick Installation Guide in Appendix B of this document.

Connecting a second BTS to the system

See section 3 of the Quick Installation Guide in Appendix B of this document.

Connecting a Range Enhancement Package

See section 4 of the Quick Installation Guide in Appendix B of this document.

System Configuration

The software configuration is vitally important to how the LTGSM operates. No matter how well the system is deployed and connected it will not work without the appropriate software settings. Most systems are delivered to the end user ready to operate out of the box with the exception of a couple of items. Those items are typically the subscriber database and the routing tables. In some instances this information is provided to TLC prior to shipment and has already been administered according to the contract and instructions. If this is the case, the system should be ready to operate as soon as you receive it, if not follow the instructions provided in this section as well as Appendix C of this document to complete the database administration. This section provides the following information:

- Previously configured parameters (System Dependant)
- Hardware and Software information
- Administration procedures using the Web Browser interface

Previously Configured Parameters

The following information is system dependant and was recorded from the LTGSM prior to shipment. While this information may appear to be part of the master configuration guide, it is changed for each individual customer.

• MSC IP Address	contact support
• Web Access Address	Local Host (127.0.0.1)
• BSC IP Address LAN #1	contact support
• User Name	pmnowner
• Password	admin

Note

Note – IP Addresses may be different depending on the end user's request.

Hardware and Software Information

With the exception of the operating system and software version the following information is system dependant and was recorded from the LTGSM prior to shipment. While this information may appear to be part of the master configuration guide, it is changed for each individual customer.

• Operating System	Windows XP
• MSC/BSC Software Version	2.0.0.14 / 3.0.64.38
• License #	XXXXX
• Chassis Type	Dell E6400 ATG

All other pertinent information can be found on the accompanying packing list.

Administration Procedures Using the Web Browser interface

It is extremely important that you read and understand the System Administrator User Guide before attempting to make administrative changes to the system.

Please refer to Appendix C “System Administrator User Guide” for all administrative procedures.

Note

***Note**: For information on how to configure the **BSC** and **BTS** please refer to the Configuration Manager user guide that is provided as a separate document.*

Upgrades to the System

TLC provides software upgrades as they become available to customers with a Software License Agreement (SLA). It should be noted that a SLA is not necessary to resolve problems with the software. If a problem should arise it will be addressed on a case by case basis. For the purposes of the guide TLC will address only those issues surrounding the SLA.

If the end user has a SLA and a software upgrade becomes available TLC will contact the user via telephone and email to inform him/her at the time of availability. The customer will be provided an FTP site from which to download the patch/software upgrade. The username and password will be provided in a separate email for security purposes. Instructions on how to apply the upgrade will be provided at the time of the download.

TLC does not provide hardware upgrades unless specified and agreed upon during the contracting phase of the business transaction. All hardware is considered operational at the time of acceptance. If a problem should arise with the hardware during the warranty period it will be repaired or replaced at no charge to the customer. All other hardware issues will be addressed on a case by case basis.

Periodic Maintenance

Due to the simplicity of the LTGSM very little maintenance is required. The following items should be performed on a periodic basis:

- Back up the configuration database (after every major system change)
- Test the system monthly to ensure it operates correctly
- Clean all components of the system with a soft damp cloth and compressed air as needed
- Test cables periodically and replace as needed.

Caution

CAUTION – Do not clean the system components when in operation. Never use a wet cloth to clean the system as there are vent holes that may allow moisture inside the chassis. If a damp cloth is used to clean the system components allow 24 hours of drying time before the next power up.

WARNING

WARNING – Never use a damp cloth on the system while it is in operation. Doing so may cause death or injury from electric shock! Always unplug any device before maintenance or cleaning.

Technical Support

TLC provides technical support to its customers based on contract requirements. The technical support department can be reached at 904-829-0323 option #3 24 hours a day. In addition each customer is provided with a user name and password to access user documentation and other important information at TLC's web site. The URL is www.toplevelcom.com/support. You must have a username and password to access documentation and software.

Appendix A – Common Acronyms

Abis	Refers to the BSC-BTS data link
ARFCN	Absolute Radio Frequency Channel Number
BCCH	Broadcast Control Channel
BSC	Base Station Controller
BSS	Base Station System
BTS	Base Transceiver Station
CPU	Central Processing Unit
CSD	Circuit Switch Data
DSP	Digital Signal Processor
EDGE	Enhanced Data Rates for GSM Evolution
FTP	File Transfer Protocol
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
GSM	Global Systems for Mobile Communications
GSN	GPRS Support Node
HLR	Home Location Registry
HPA	High Power Amplifier
IP	Internet Protocol
ISDN	Integrated Services Digital Network
MCPA	Multi-Carrier (High) Power Amplifier
MMS	Multimedia Message Service
MMSC	Multimedia Messaging Service Center
MS	Mobile Station
MSC	Mobile Switching Center
OMC-R	Operations Maintenance Center – Radio
PBX	Private Branch Exchange
PRI	Primary Rate Interface
PSTN	Public Switched Telephone Network
RF	Radio Frequency
SCPA	Single Carrier Power Amplifier
SGSN	Serving GPRS Support Node
SMS	Short Message Service
SMSC	Short Messaging Service Center

TRAU	Transcoder and Rate Adaptation Unit
VLR	Visitor Location Registry

Appendix B – Quick Deployment Guide

CONVENTIONS USED

WARNING – Alerts the reader to a situation that might affect personal safety.

CAUTION – Alerts the reader to a situation that might affect the integrity of equipment, software or data.

NOTE – Provides the reader with important or supporting information.

STOP – Informs the reader that a procedure is finished.

STRAIGHT ETHERNET CABLE

CROSS OVER ETHERNET CABLE

SMA MALE TO SMA MALE (TX)

SMA MALE TO SMA MALE (RX)

N-Type Male to 7/16 DIN Male (ANT)

Deploying the system '*without*' the use of an Ethernet HUB or Switch

Set-Up ***Without*** Ethernet HUB or Switch

Step # 1:

Insert Security Dongle into any available USB port.

Set-Up ***Without*** Ethernet HUB or Switch

Step # 2:

Connect the LAN port on the Laptop to the LAN port on the BTS Power Block using an Ethernet crossover cable.

CAUTION

DO NOT PLUG THE CABLE INTO THE BTS SIDE OF THE BTS POWER BLOCK. THIS PORT PROVIDES POE (Power Over Ethernet) [48 VDC] FOR THE BTS. IF THESE PORTS ARE MISTAKEN THE LAPTOP COULD BE DAMAGED!!!

NOTE

ENSURE THAT A CROSSOVER CABLE IS USED BETWEEN THE LAPTOP MSC AND THE POWER BLOCK. THIS IS ONLY NECESSARY WHEN A HUB OR SWITCH IS NOT USED.

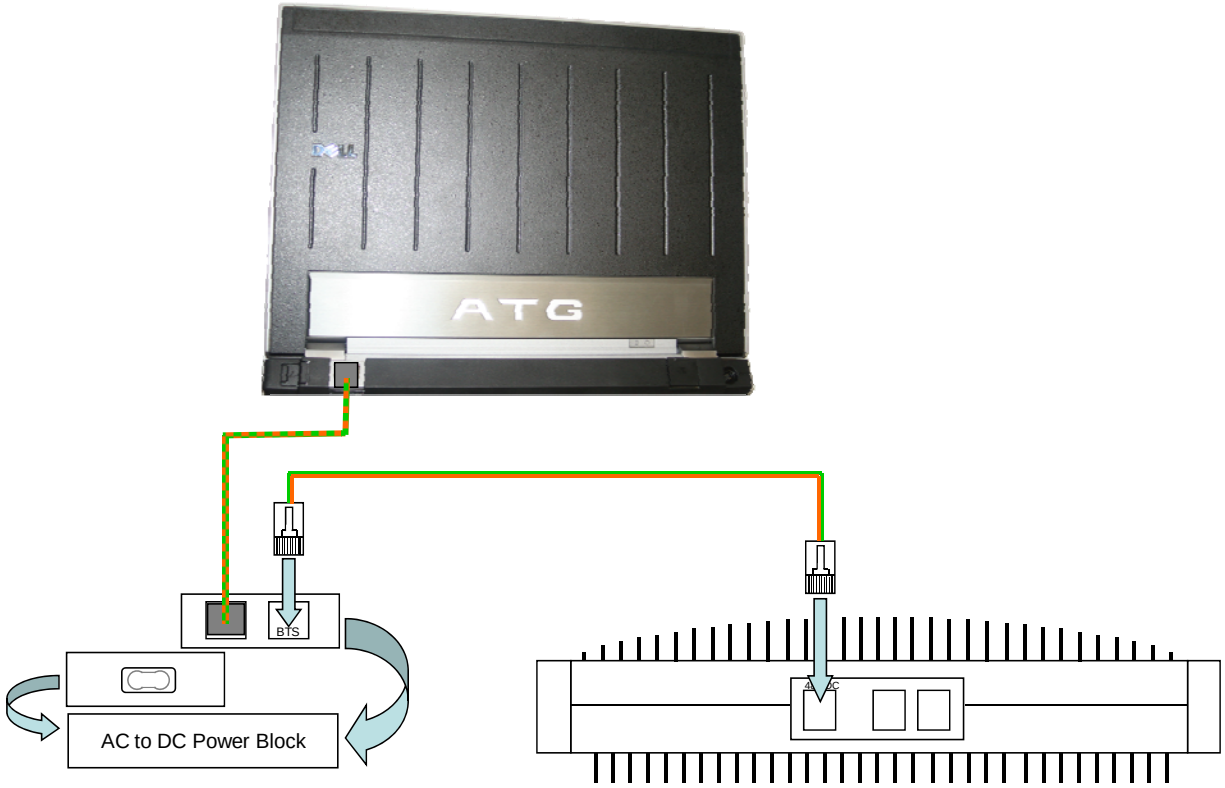
Set-Up ***Without*** Ethernet HUB or Switch

Step # 3:

Connect the BTS port on the BTS Power Block to the main Ethernet Port on the BTS. This port can be identified by the 48 VDC marking above it. This connection will be accomplished with a straight through Ethernet cable.

NOTE

ENSURE THAT A STRAIGHT THROUGH CABLE IS USED BETWEEN THE POWER BLOCK AND THE BTS. OTHERWISE THE SYSTEM WILL NOT WORK



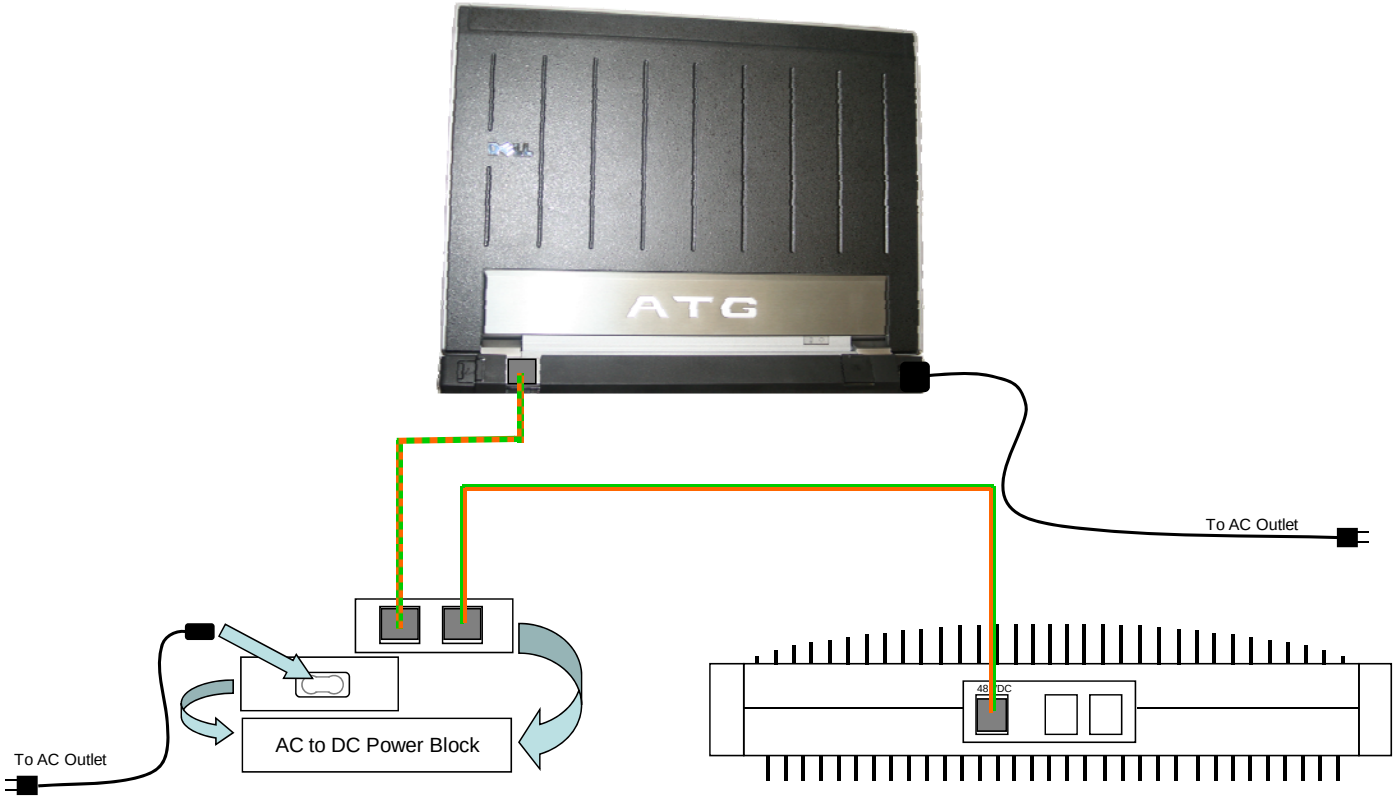
Set-Up ***Without*** Ethernet HUB or Switch

Step # 4:

Connect the AC Power to both the Laptop and the BTS Power Block.

WARNING

ALWAYS USE CAUTION WHEN PLUGGING IN AC ADAPTER. SERIOUS INJURY OR DEATH COULD BE CAUSED BY ELECTRIC SHOCK!!!



Set-Up ***Without*** Ethernet HUB or Switch

Step # 5:

Press the power button above the keyboard on the laptop.

THIS COMPLETES THE SET-UP WHEN DEPLOYED WITHOUT AN ETHERNET HUB OR SWITCH.

Deploying the system '*with*' the use of an Ethernet HUB or Switch

Set-Up ***With*** Ethernet HUB or Switch

Step # 1:

Insert Security Dongle into any available USB port.

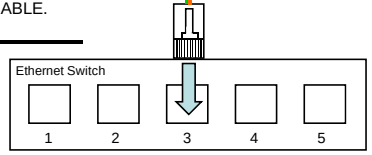
Set-Up ***With*** Ethernet HUB or Switch

Step # 2:

Connect the LAN on the Laptop to any of the LAN ports on the Ethernet Switch (except port 5).

NOTE

IT IS NOT NECESSARY TO USE CROSSOVER CABLES WHEN CONNECTING DEVICES THROUGH A HUB OR SWITCH.



NOTE

PORT 5 ON THE ETHERNET SWITCH IS AN UPLINK PORT. DO NOT USE THIS PORT UNLESS IT NECESSARY. IF THE PORT IS USED IT WILL REQUIRE A CROSSOVER CABLE.

Set-Up ***With*** Ethernet HUB or Switch

Step # 3:

Connect any port on the Ethernet Hub (except port 5) to the LAN port on the BTS Power Block.

CAUTION

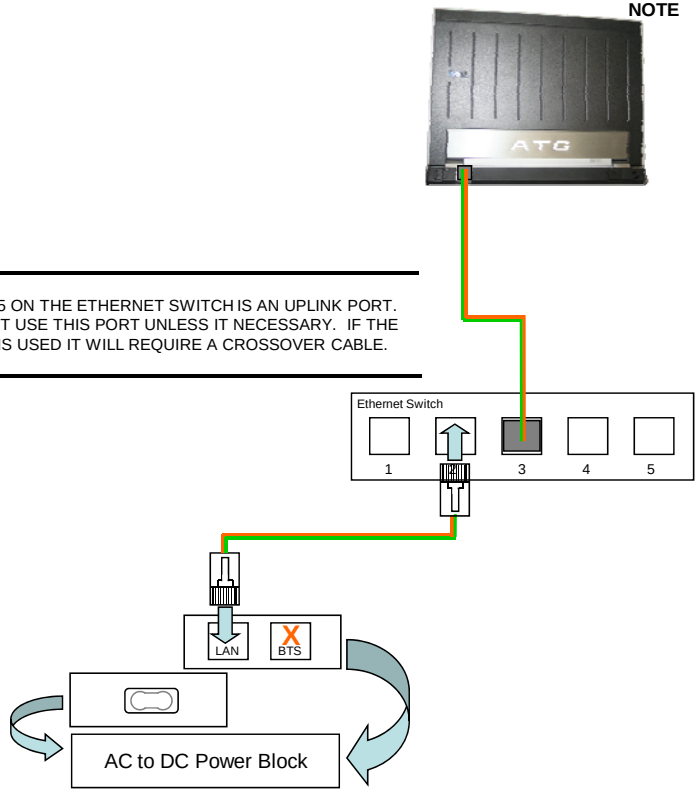
DO NOT PLUG THE CABLE INTO THE BTS SIDE OF THE BTS POWER BLOCK. THIS PORT PROVIDES POE (Power Over Ethernet) [48 VDC] FOR THE BTS. IF THESE PORTS ARE MISTAKEN THE ETHERNET SWITCH COULD BE DAMAGED!!!

NOTE

IT IS NOT NECESSARY TO USE CROSSOVER CABLES WHEN CONNECTING DEVICES THROUGH A HUB OR SWITCH.

NOTE

PORT 5 ON THE ETHERNET SWITCH IS AN UPLINK PORT. DO NOT USE THIS PORT UNLESS IT NECESSARY. IF THE PORT IS USED IT WILL REQUIRE A CROSSOVER CABLE.



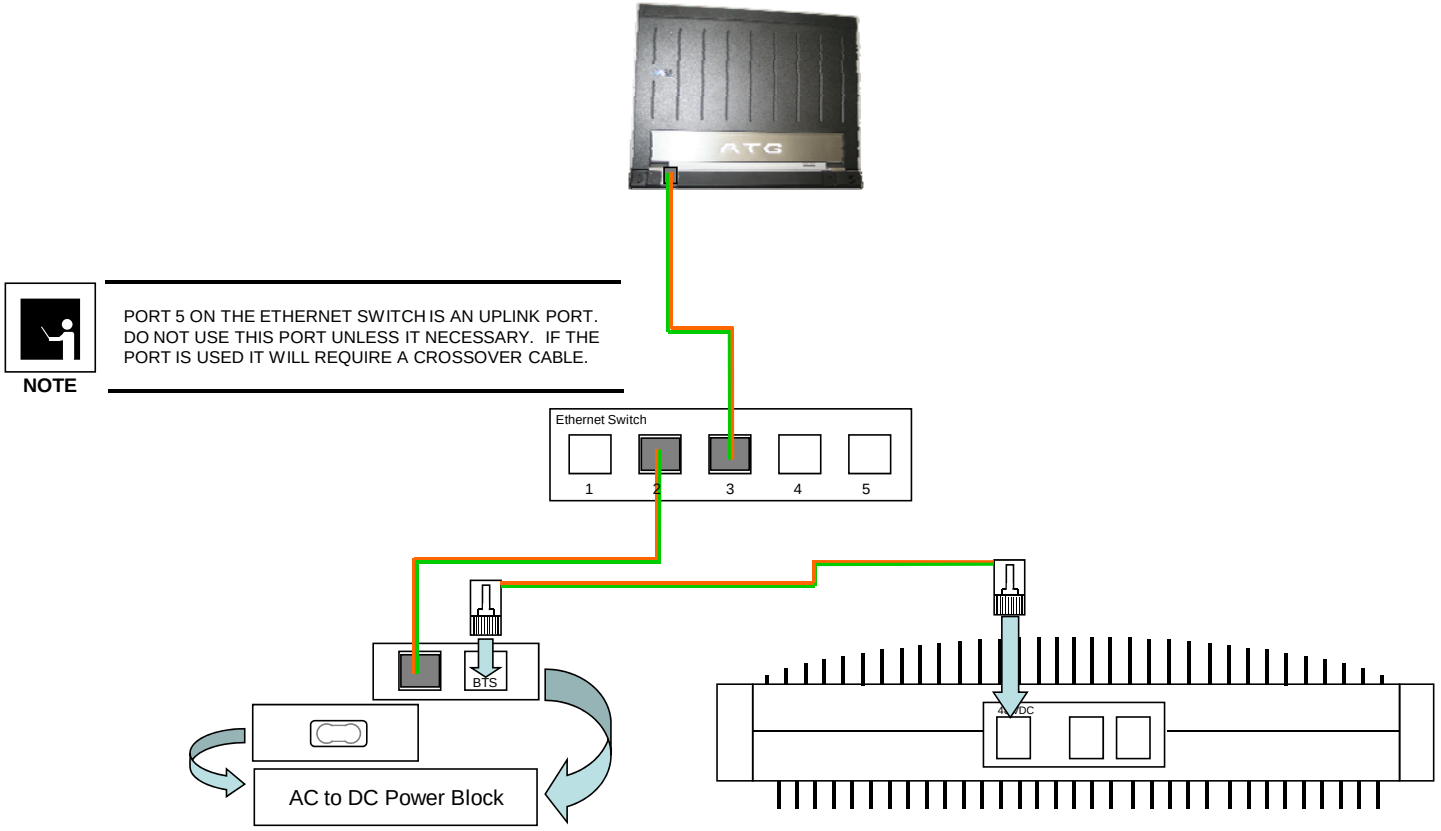
Set-Up *With* Ethernet HUB or Switch

Step # 4:

Connect the BTS port on the BTS Power Block to the Main Ethernet port on the BTS labeled 48 VDC

NOTE

IT IS NOT NECESSARY TO USE CROSSOVER CABLES WHEN CONNECTING DEVICES THROUGH A HUB OR SWITCH.



NOTE

PORT 5 ON THE ETHERNET SWITCH IS AN UPLINK PORT. DO NOT USE THIS PORT UNLESS IT NECESSARY. IF THE PORT IS USED IT WILL REQUIRE A CROSSOVER CABLE.

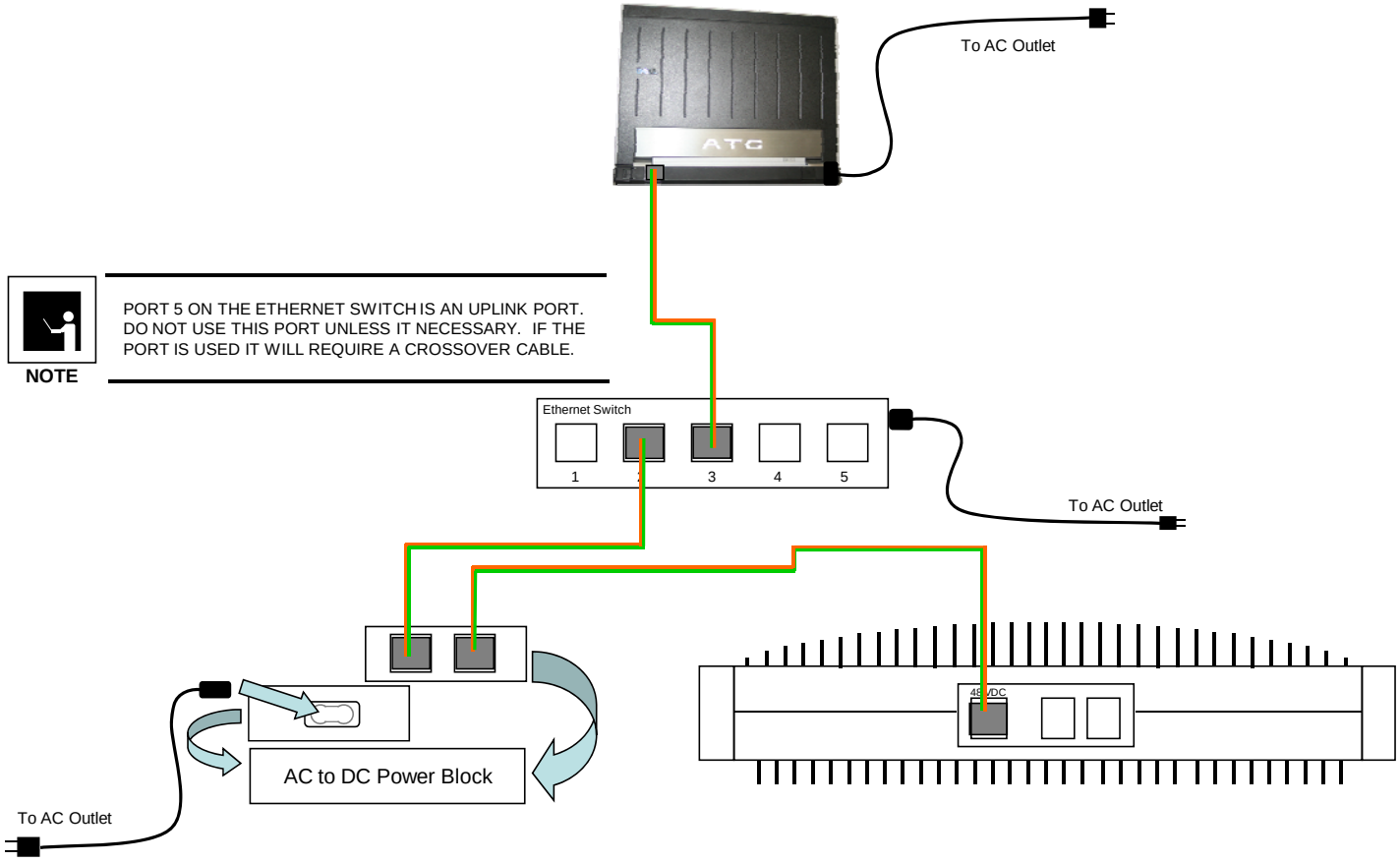
Set-Up *With* Ethernet HUB or Switch

Step # 5:

Connect the AC Power to both the Laptop and the BTS Power Block.

WARNING

ALWAYS USE CAUTION WHEN PLUGGING IN AC ADAPTER. SERIOUS INJURY OR DEATH COULD BE CAUSED BY ELECTRIC SHOCK!!!


To AC Outlet
ATG
NOTE
PORT 5 ON THE ETHERNET SWITCH IS AN UPLINK PORT. DO NOT USE THIS PORT UNLESS IT NECESSARY. IF THE PORT IS USED IT WILL REQUIRE A CROSSOVER CABLE.
Ethernet Switch
1
3
4
5
To AC Outlet
AC to DC Power Block
To AC Outlet

Set-Up ***With*** Ethernet HUB or Switch

Step # 6:

Press the power button on the front of the MSC.

THIS COMPLETES THE SET-UP WHEN DEPLOYED WITH AN ETHERNET HUB OR SWITCH.

CONNECTING A SECOND BTS

Adding a Second BTS to the Network

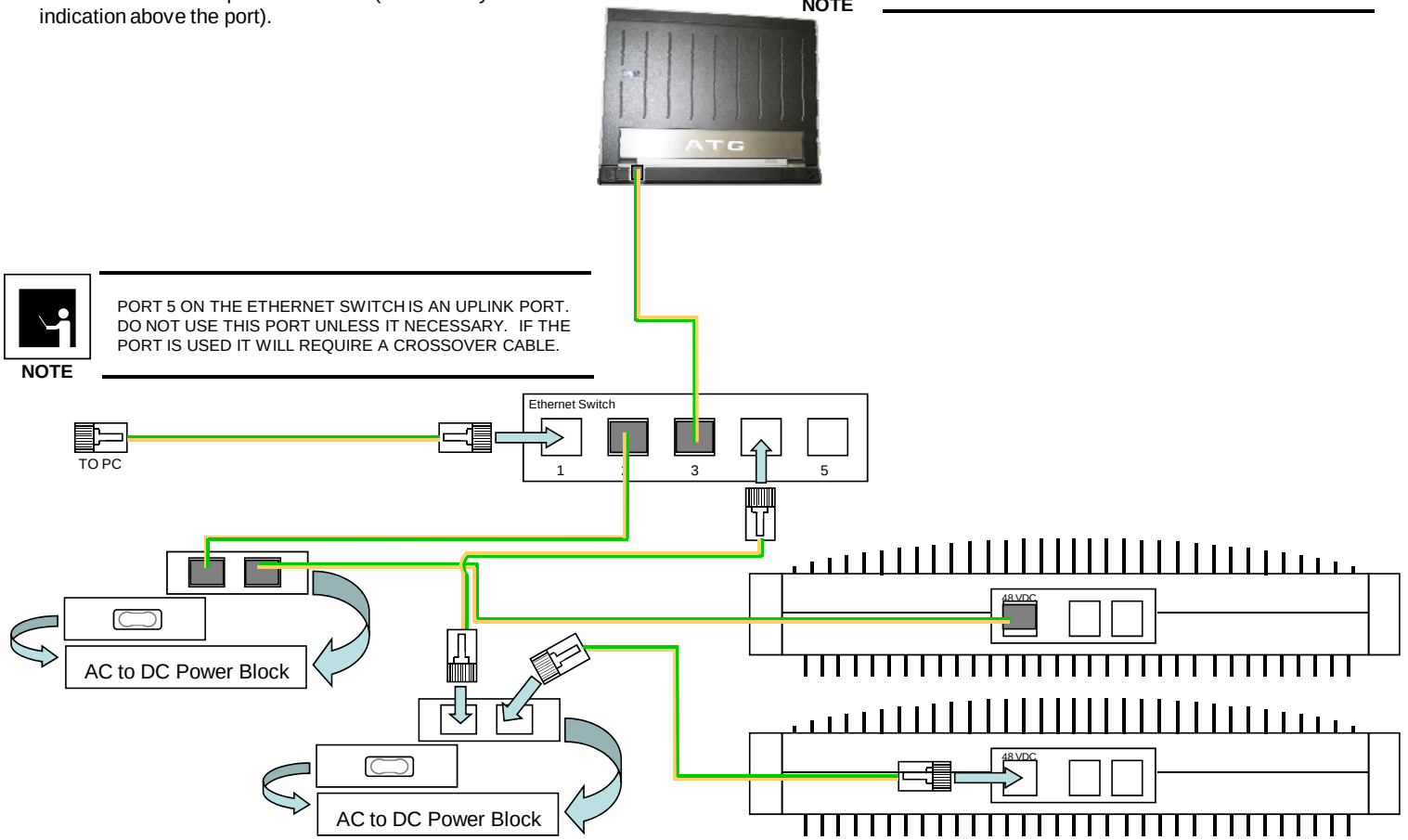
To connect a second base station to the Laptop MSC/BSC simply add the second BTS Power Block and connect the LAN port from the BTS Power Block to any open LAN ports on the Ethernet switch. After connecting the Power Block to the Ethernet switch, connect the BTS port of the BTS Power Block to the main Ethernet port on the BTS (identified by the 48 VDC indication above the port).

CAUTION

ENSURE THAT THE BTS SIDE OF THE POWER BLOCK IS ONLY PLUGGED INTO THE BTS. THIS PORT PROVIDES POE (Power Over Ethernet) [48 VDC] FOR THE BTS. IF THESE PORTS ARE MISTAKEN THE ETHERNET SWITCH COULD BE DAMAGED!!!

NOTE

SEVERAL BTSs CAN BE ADDED TO THE LAPTOP MSC/BSC BY FOLLOWING THESE SAME INSTRUCTIONS. REMEMBER THE SITES MUST ALSO BE ADDED IN THE BSC ADMINISTRATION CONSOLE



NOTE

PORT 5 ON THE ETHERNET SWITCH IS AN UPLINK PORT. DO NOT USE THIS PORT UNLESS IT NECESSARY. IF THE PORT IS USED IT WILL REQUIRE A CROSSOVER CABLE.

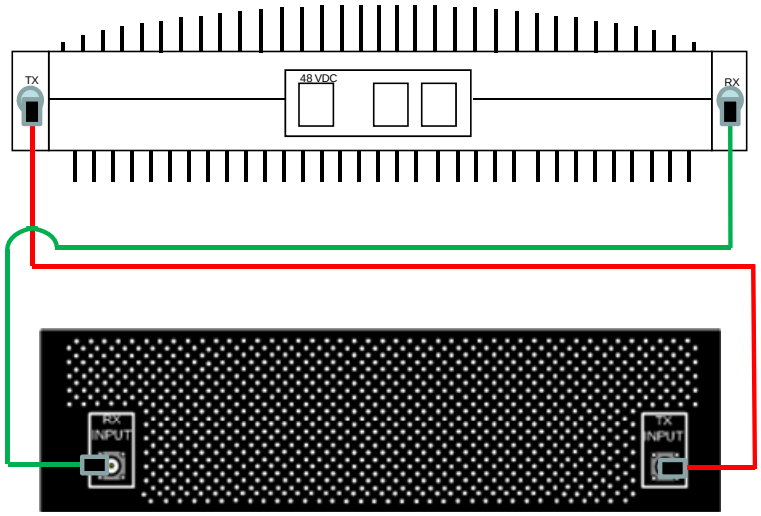
THIS COMPLETES THE SET-UP FOR CONNECTING TWO OR MORE BTSs.

CONNECTING THE RANGE ENHANCEMENT PACKAGE (REP)

Connecting the Range Enhancement Package

Step # 1:

Connect the BTS TX port to the REP TX Input port and then connect the BTS RX port to the REP RX Input port using the SMA Male to SMA Male cables provided.



Connecting the Range Enhancement Package

Step # 2:

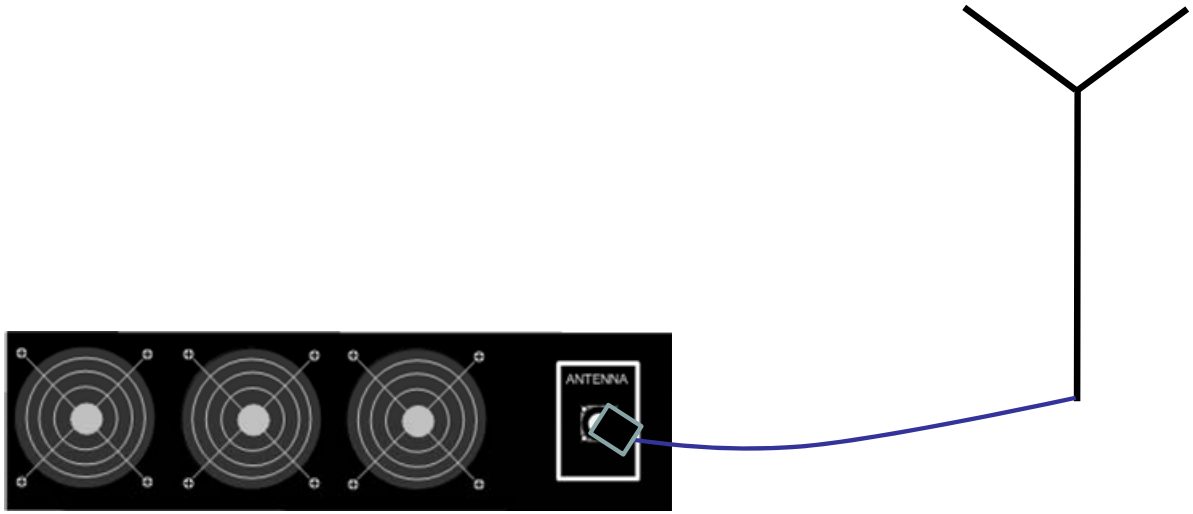
Connect the REP Antenna port to an appropriate antenna using an N Type Male connector on the REP side of the cable.

CAUTION

DO NOT POWER ON THE REP WITHOUT AN ANTENNA OR OTHER APPROPRIATE LOAD ON THE ANTENNA PORT. RUNNING THE REP WITHOUT A LOAD MAY CAUSE DAMAGE TO THE INTERNAL POWER AMPLIFIER.

NOTE

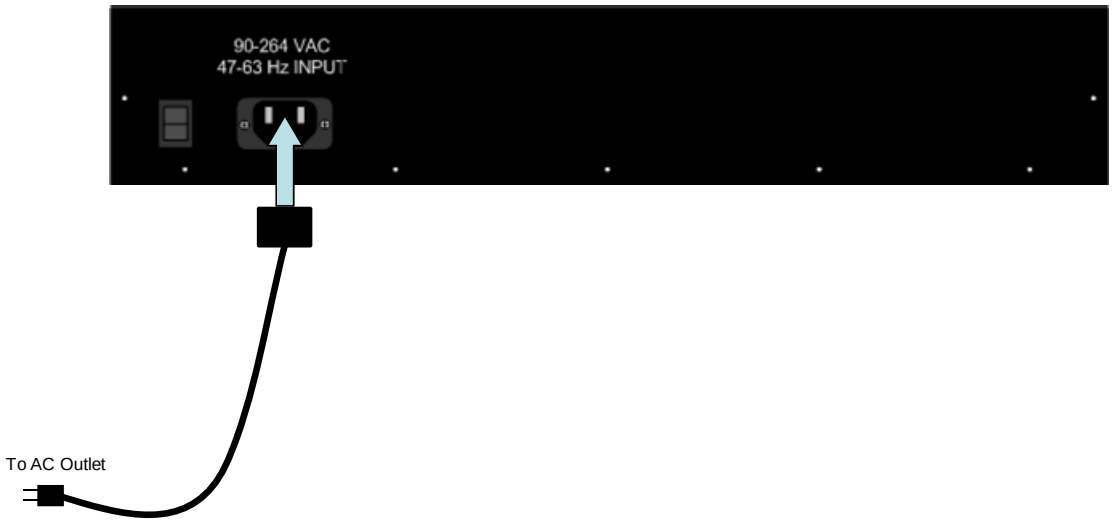
ALL CABLES, ANTENNAS AND LOADS SHOULD BE RATED AT 50 OHMS.



Connecting the Range Enhancement Package

Step # 3:

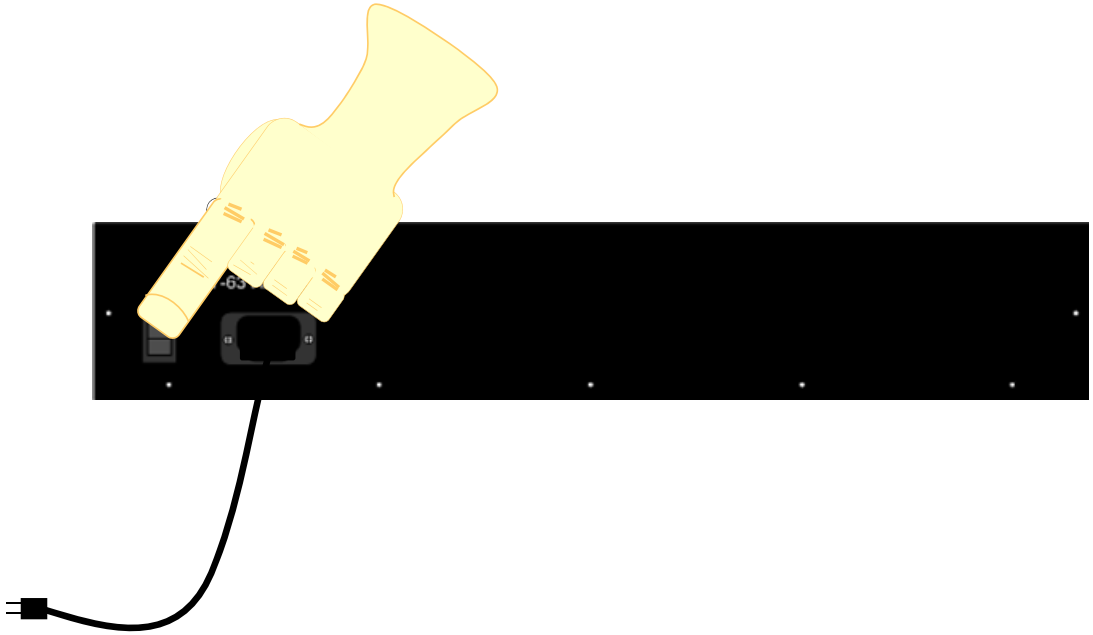
Connect AC power to the REP.



Connecting the Range Enhancement Package

Step # 4:

Toggle the power button next to the AC entry point to the on position.



Connecting the Range Enhancement Package

Step # 5:

The blue LED on the from of the REP should illuminate and the power meter should indicate an estimated power output level.

NOTE

THE POWER METER IS SIMPLY AN INDICATOR OF OUPUT POWER AND MAY NOT REFLECT THE ACTUAL RF OUTPUT.

THIS COMPLETES THE SET-UP WHEN CONNECTING THE BTS TO THE REP

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APPENDIX C Configuration Guide

Introduction

This document introduces the Management System of the LTGSM solution and should initially be read in conjunction with the Quick Start Guide for the LTGSM. The Quick Start Guide details how to physically connect-up your LTGSM.

This System Administrator User Guide can be used as a training and/or reference document by anyone who requires access to the Management System in order to configure, administer, register handsets or support the LTGSM. Typically this is likely to be a Network Manager, System Administrator, Telecoms Administrator or a Support member of staff.

Anyone needing to use the LTGSM Management System should refer to the following section of this document for further information on how to use the LTGSM interface:

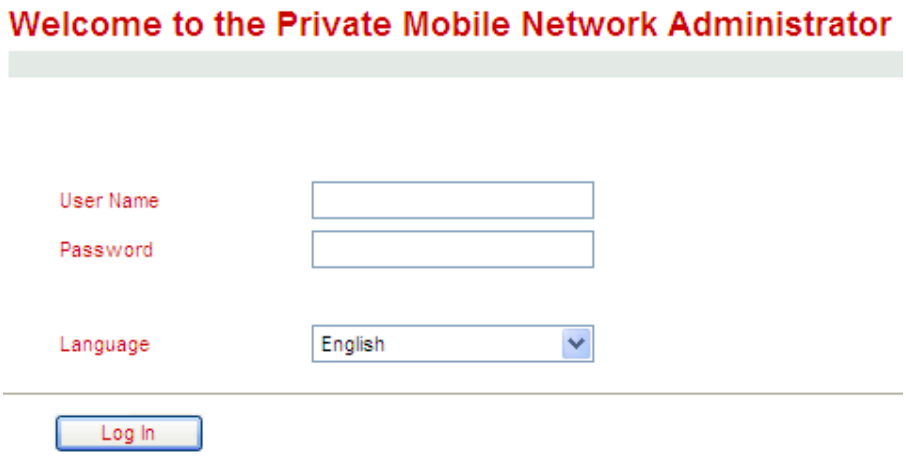
Starting your PMN system configuration

PMX Administrator must first be installed on a server (running IIS) on the PMX system. For details of how to install PMX Administrator, please refer to the PMX Administrator installation guide.

Launch PMX Administrator either from the Private Mobile Networks program group on the start menu of the server where it was installed,

or from a desktop shortcut or browser from any other PC with access to the network.

You will be prompted to enter your user credentials.



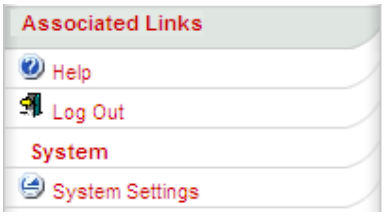
Having logged into PMX Administrator, you will be presented with a screen as shown below:

Tenancies

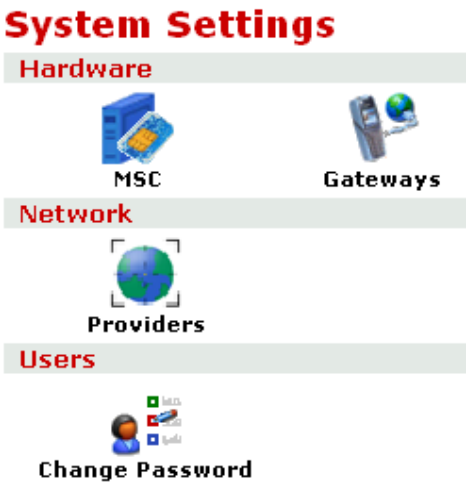
**Tenancy ID	Name
1	Customer A
4	Customer B

For a brand new system, there will be no existing tenancies.

You should first select ‘System Settings’ in order to add a new ‘provider’:



You will be presented with the ‘System Settings’ menu:

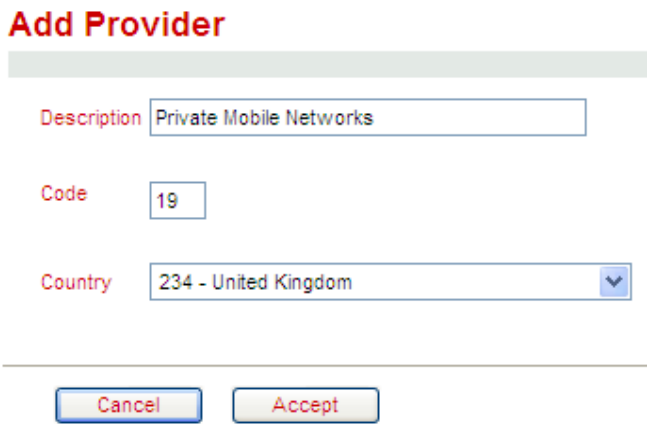


Provider Configuration

'Location Area' coverage is provided by a variety of companies in many countries. The provider giving coverage within an area is made known to and displayed on the handset. Each country is assigned a 3-digit identifier code, or codes, and each company authorized to give GSM coverage is given a 2-digit identifier code. Therefore, the PMX system allows 'providers' to be added so they can be allocated to individual location areas (see section on location areas).

In most cases PMX systems will use the 2-digit identifier allocated to PMN by Ofcom and this will be the only provider configured on the system. As shown below, this will normally be set to code 19 in country 234. In cases where PMN provide coverage on behalf of another mobile operator, the other operator's code may be entered. For demonstration equipment, code 01 and country 001 may be used as these are development codes.

Click on the 'Providers' icon to be presented with the providers list, then click on 'Add Provider' to enter details of the new provider.

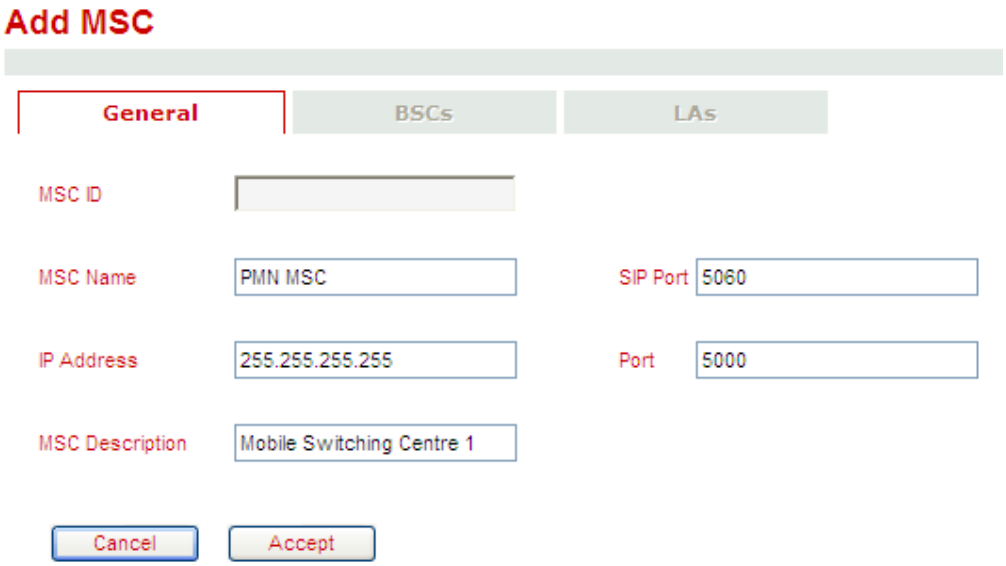


Once added to the system, a provider may be edited but not deleted.

MSC Configuration

Creating a Mobile Switching Centre (MSC) will set up the top level of your system hierarchy. Having selected ‘MSCs’ from the ‘System Settings’ menu, you will be presented with the MSC list:

Select ‘Add MSC’ to add details of the MSC:

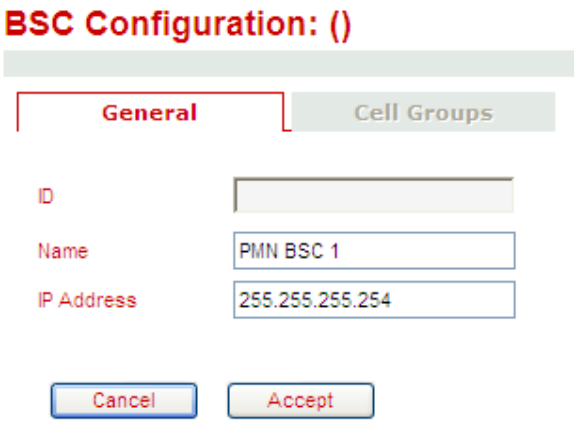


Enter details as given on your network diagram and click ‘Accept’.
NOTE : The loop back IP address of 127.0.0.1 should never be used as the MSC will fail to start.

BSC Configuration

This will create the second level of the hardware hierarchy.

Select ‘Add BSC’ to configure the BSC:



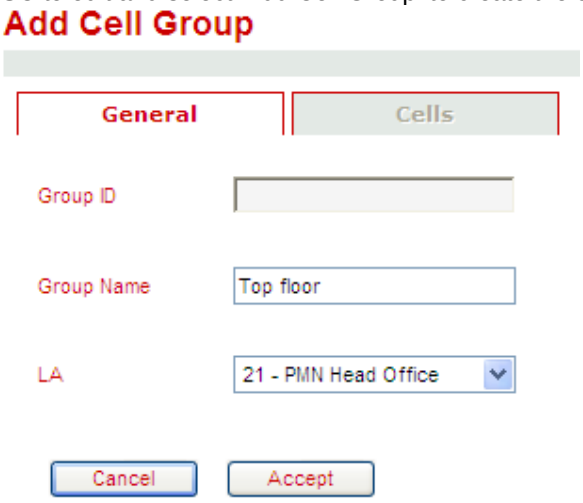
Enter details as given on your network diagram and click ‘Accept’. Repeat the process as required to create all BSC’s on the network.

N.B. The configuration of cell groups (and therefore cells) must be done via the BSC settings. Please note that, whilst cell groups will be listed under Location Areas, they may only be configured within the BSC, not the LA.

Cell Group Configuration

This will create the second layer of the virtual hierarchy.

Select the required BSC to edit and select ‘Add Cell Group’ to create the cell group:



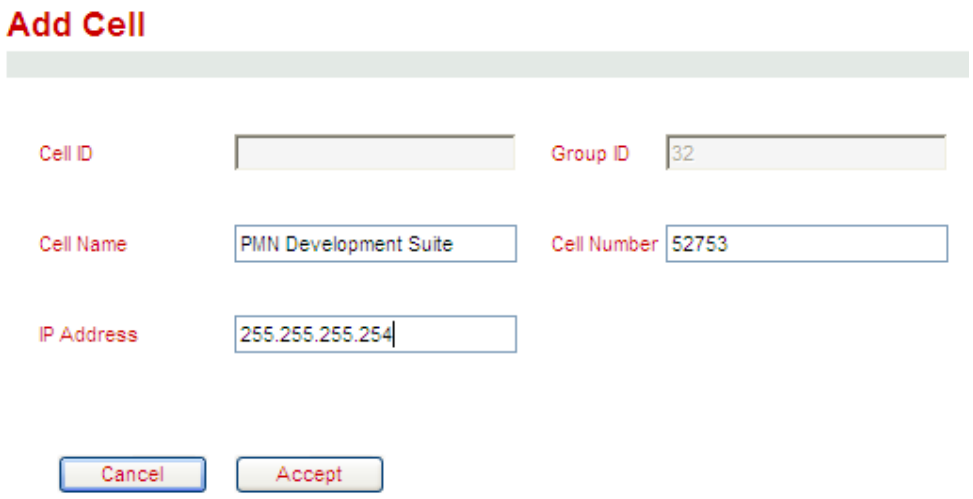
Define a suitable name and choose the required LA from the list and click ‘Accept’. Repeat the process as necessary to create all cell groups required on the network.

Reminder: Although cell groups may be viewed from within LA settings, they may only be configured via the BSC.

Cell Configuration

This will create the final layer of the hardware hierarchy.

Select your required cell group to edit and select ‘Add Cell’ to be presented with the ‘Add Cell’ screen:



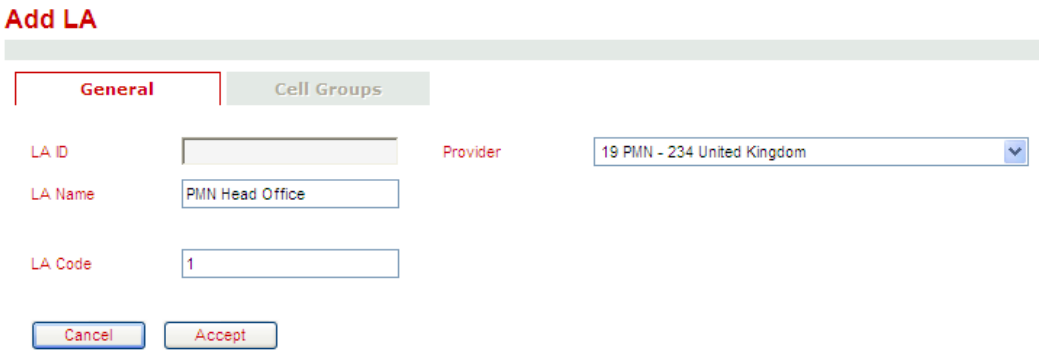
Enter details as given on your network diagram and click ‘Accept’. (The ‘Cell Number’ can be obtained from the BSC configuration software). Repeat the process as required to create all cells in the cell group.

Hardware configuration is now complete and you can move on to the tenancy configuration.

LA Configuration

This will create the first layer within the virtual hierarchy.

Select ‘Add Location Area’ to configure the LA:

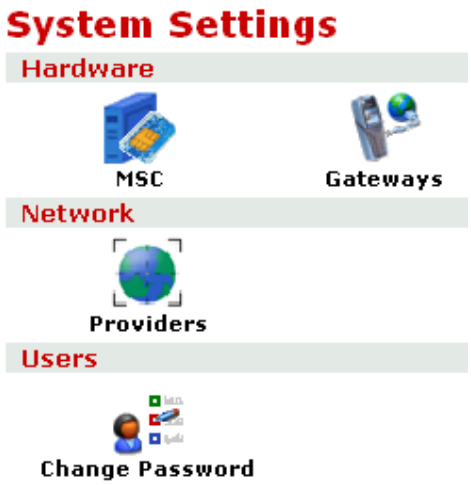


Enter details as given on your network diagram along with the appropriate provider and click ‘Accept’. The ‘LA Code’ number can be obtained from the BSC configuration software. Normally, there will only be one provider given in the drop down list. Repeat process as required to create all LA’s on the network.

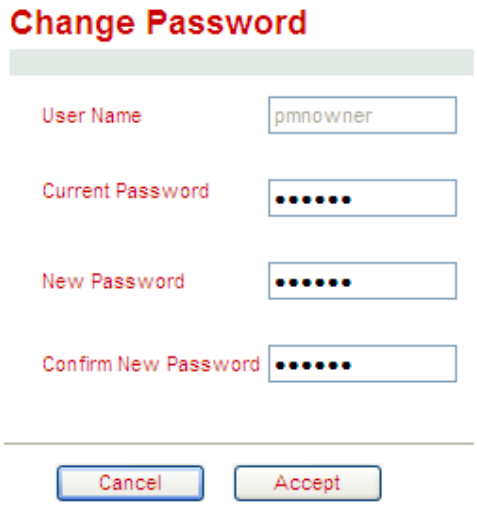
Having now created an MSC, at least one BSC and at least one LA, you can now create new cell groups to be assigned to your LA(s) and new cells to be assigned to your cell group(s).

PMX Administrator Password Change

For security reasons, you may wish to change your PMX administrator's password. This can be done by selecting the password change option from the 'System Settings' menu:



From there, you will be prompted to enter the current password, followed by the new password you wish to use, then to confirm that new password and accept the change.



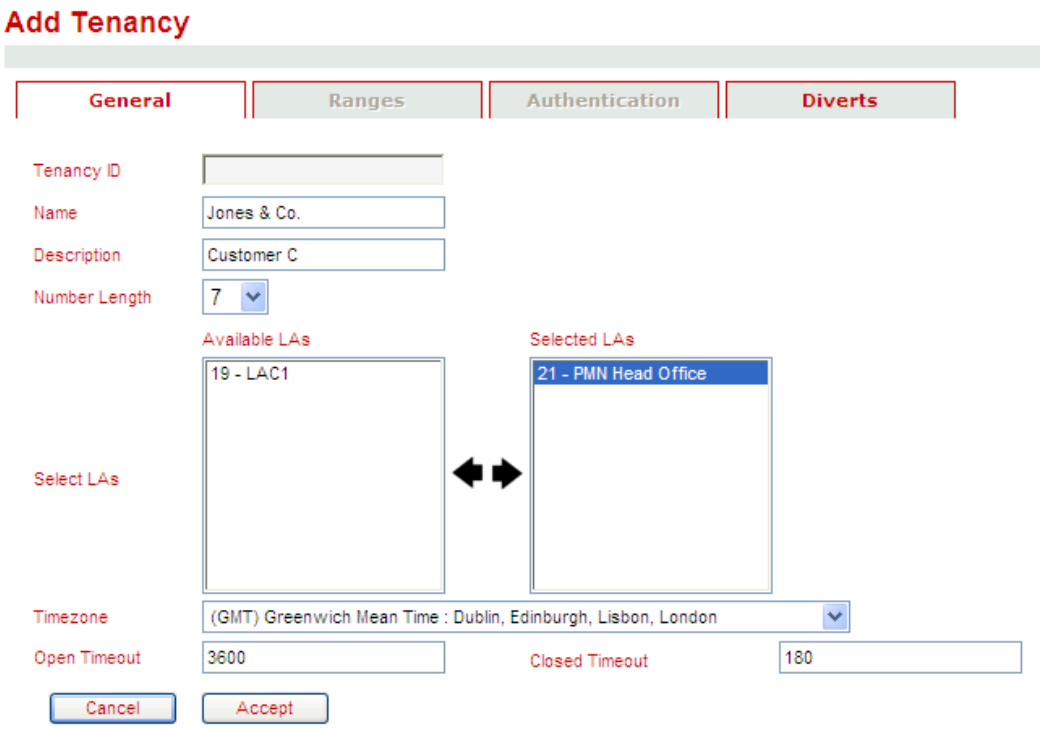
Tenancy Configuration

Having configured the hardware, browse to the ‘Tenancies’ screen by using the ‘Tenancy List’ link from any page:

You will be presented with the list of tenancies:

For a brand new system, there will be no existing tenancies.

Select ‘Add Tenancy’ and you will be presented with the ‘Add Tenancy’ screen:



General Tab

Enter a name which will be displayed in the tenancy list and add a description if required.

The length of your PMX extension numbers should be defined from the drop down list.

Location Areas will be listed in ‘Available LAs’ and can be moved into the ‘Selected LAs’ list.

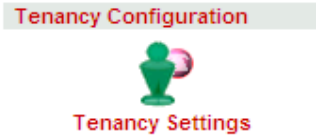
The PMX system may be installed and run in one country but used by people in several different countries. Therefore, you may set which time zone the tenancy uses so that information relevant to the tenancy’s local time may be used. The local time will relate to the sending of SMS messages and to call logging / billing.

The ‘Open Timeout’ setting defines the maximum number of minutes you expect users to remain on a single call. Mobile handsets attempt to re-register periodically with their network, the norm being every 90 minutes. This process cannot take place whilst the handset is on a call. Therefore, the re-registration may be delayed. The open timeout will cater for this scenario by keeping the registration alive for the set time if PMX thinks the extension is on a call. After this time, PMX will deem that the call should have terminated and the extension will be un-registered from the system. If the call is still in progress, it will be allowed to continue but PMX will treat the extension as being “off net”.

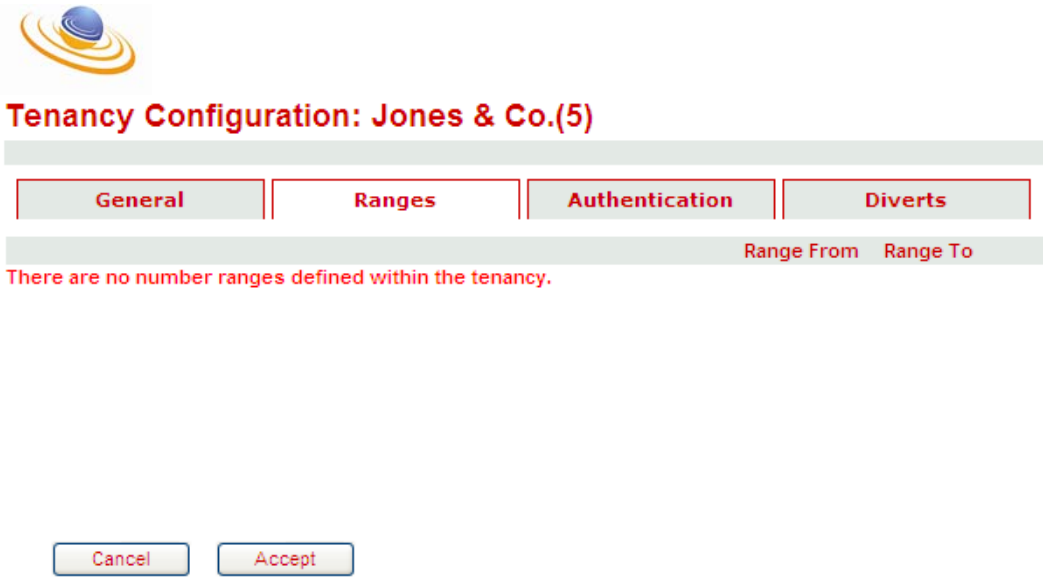
The ‘Closed Timeout’ setting defines the number of minutes PMX will keep the extension registered when not on a call. As stated above, the handset should attempt to re-register periodically. If it fails to do so within the closed timeout period, PMX will deem that the handset has been switched off, has roamed out of the PMX network range or switched to another network.

Ranges Tab

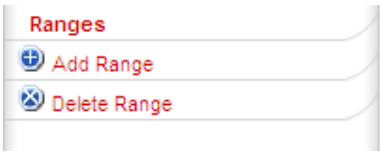
From the Tenancy List, select the tenancy you have just created and, in the ‘Tenancy Menu’, click on the ‘Tenancy Settings’ icon:



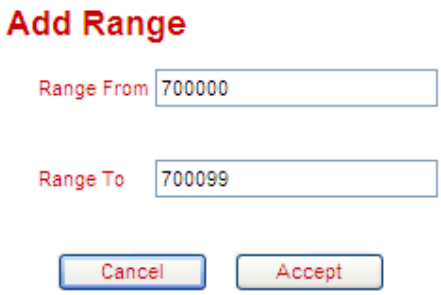
This will take you back to the details in order to create a number range:



Click ‘Add Range’ in order to create a range of extension numbers to which SIM cards may be allocated.



Enter the required range then click ‘Accept’ to accept the defined numbers.



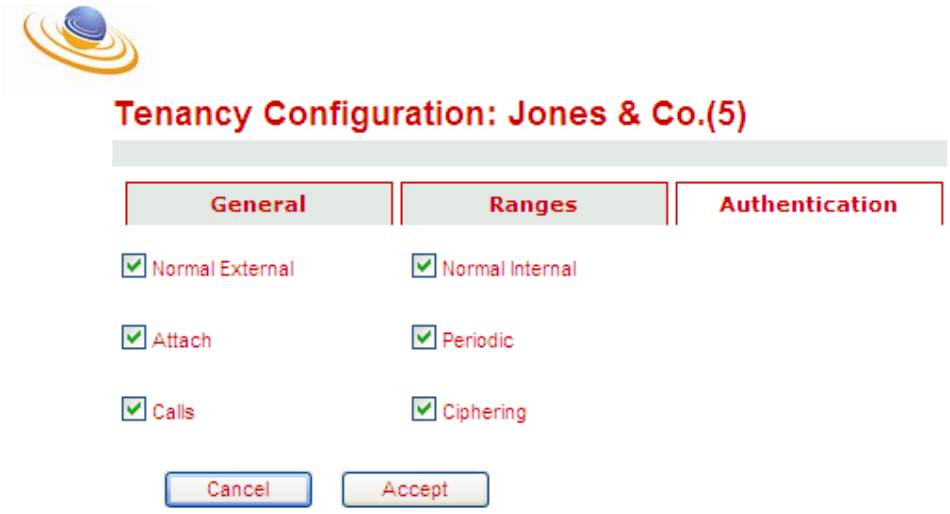
Once the Tenancy has at least one number range defined, you can start associating SIM cards with the telephone network extension numbers within the range(s).

No tenancy may use a numbering range which overlaps with that of another tenancy.

A tenancy may have multiple ranges but they must share a common number length as defined in the ‘Tenancy Configuration’ screen.

Authentication Tab

The required levels of security offered by the PMX system should be determined for the tenancy. By default, all options are selected.



Normal External
When ticked, authentication will be required upon the handset roaming from an 'external' cell (i.e. macro network), to a PMX cell.

Normal Internal
If ticked, authentication will be required when a handset roams from one PMX cell to another.

Attach
When this option is ticked, PMX will attempt to authenticate the SIM when the extension attempts to register back on the network.

Calls
When selected, this option sets PMX to authenticate the SIM whenever the extension attempts to make a call.

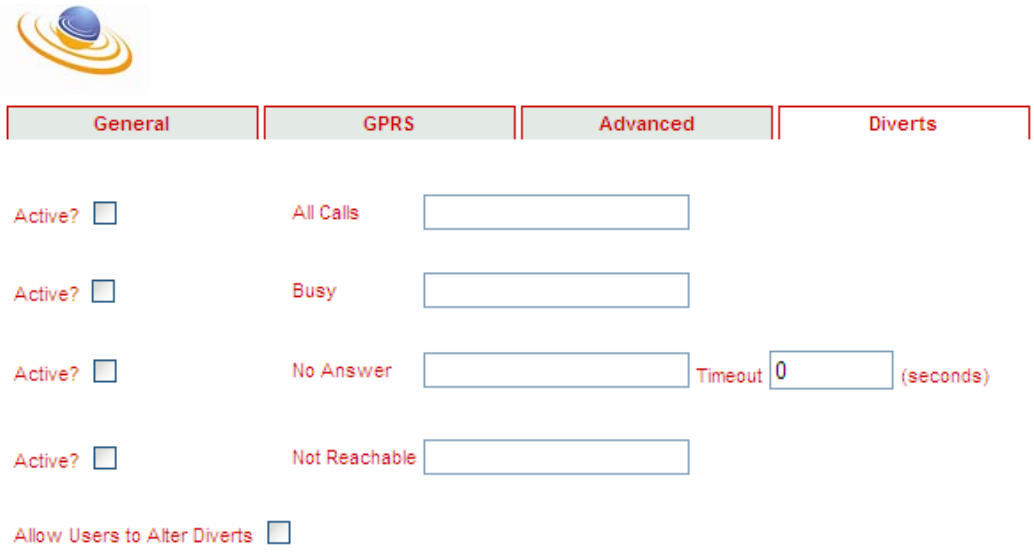
Periodic
Each mobile handset will attempt to re-register regular intervals – the norm being 90 minutes. The frequency is set in the IP Access configuration. This setting determines whether or not PMX attempts to authenticate the SIM with each re-registration. If un-ticked, the mobile will be allowed to re-register without authenticating again.

Ciphering
Allows the radio traffic between handsets and cells to be scrambled. The encryption algorithms are set on each cell in the IP Access configuration.

For further information about authentication, please refer to the authentication settings for extensions.

Diverts Tab

There may be a requirement to forward / divert calls to other destinations under certain conditions. For example, you may wish to divert calls to a voicemail system or a switchboard if an extension is busy. These diverts may either be set at tenancy level, i.e. all extensions within the tenancy will follow the same diverts (unless overridden by an extension-specific divert) or on individual extensions. The diverts tab within the 'Tenancy Settings' will apply the rules for all extensions within the tenancy.



Active?
Against each divert type is a tick box labelled ‘Active?’. When ticked, the divert will become active and, when un-ticked, the divert destination will remain but the divert will no longer be active.

All Calls
Otherwise known as an ‘unconditional’ or ‘immediate’ divert, the number defined in this field will be called under all circumstances. Caution should be exercised when activating this divert, especially at tenancy level, as calls will no longer route to handsets. This divert, once activated, will take precedence over all other divert types.

Busy
Allows an alternative point of answer to be defined when extensions are busy on another call and no second line is enabled on the extension / handset.

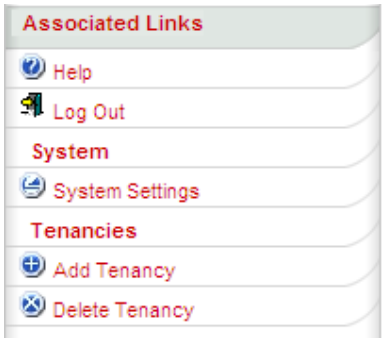
No Answer
Sets an alternative point of answer when calls give no reply within the ringing duration set in ‘Timeout’.

Timeout
Defines the number of seconds the system will wait for an answer from the extension before following the ‘No Answer’ divert to the defined number.

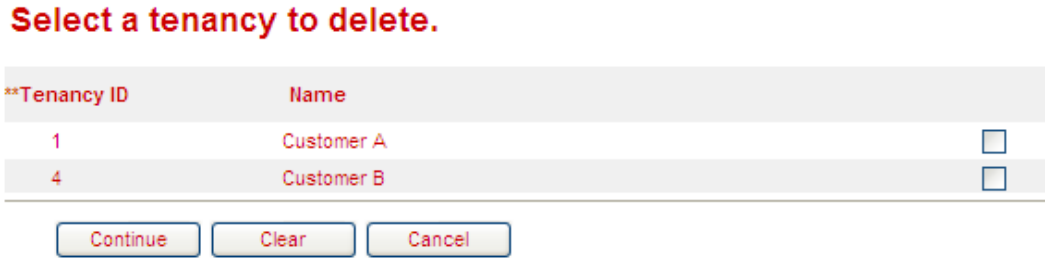
Not Reachable
In circumstances where it can no longer be established that the extension is registered on the system i.e. the handset is switched off, is no longer within range of an access point or has roamed to another network, the system will divert calls to the number defined here.

Allow Users to Alter Diverts
The diverts set on this tab may be defined exclusively by the administrator, in which case this box should remain un-ticked, or you may wish to tick the box in order to allow divert commands from handsets to update the divert destinations.

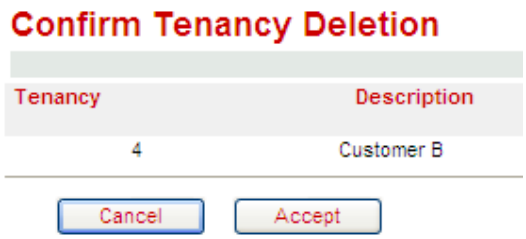
Should you need to remove a tenancy from the system, this can be done by selecting ‘Remove Tenancies’ from the ‘Associated Links’ options in the ‘Tenancy Settings’ section.



From the list of Tenancies offered, select those to be deleted by ticking the box for the tenancy then click ‘Continue’ at the bottom of the screen.



You will be prompted to ‘Accept’ or ‘Cancel’ the deletion. Please exercise caution when using this facility as tenancy settings cannot be restored once deleted.



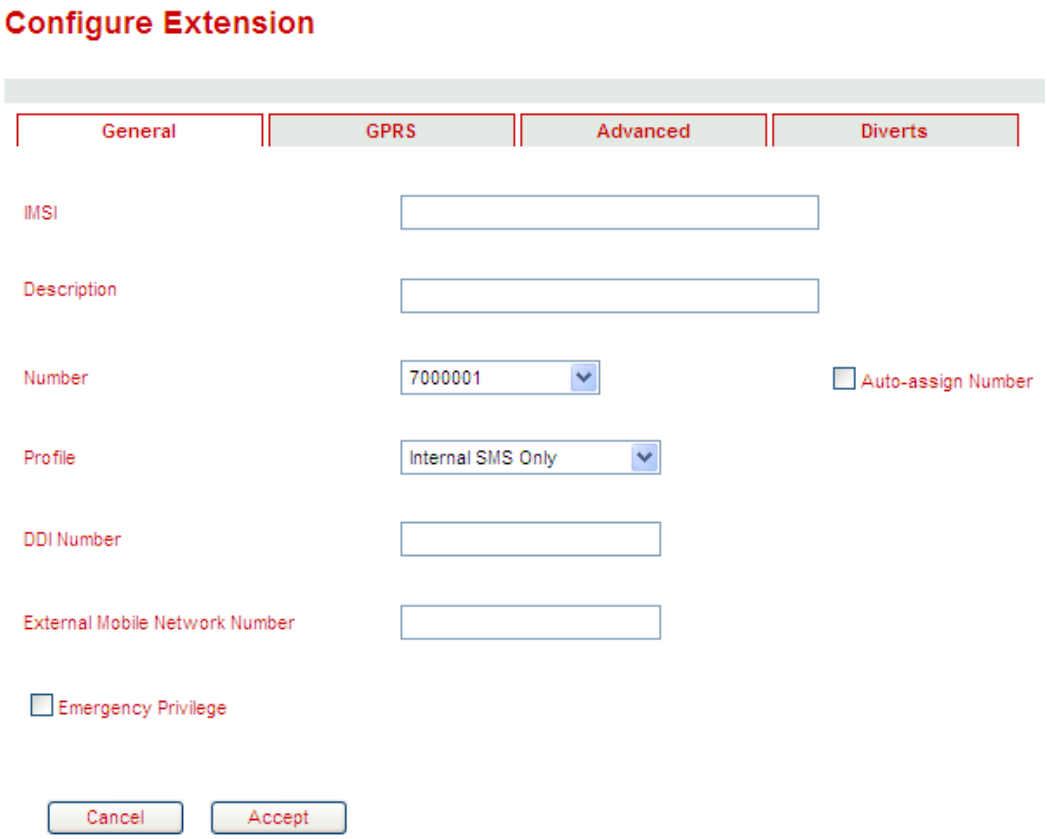
SIM Card and Extension Number Configuration

There are two different ways to provision a SIM card against a particular extension number. The method used will depend upon whether or not you know the unique ID (IMSI) of the SIM card to be provisioned. If the IMSI is known to you, method 1 is the simpler method of provisioning the SIM card.

Provisioning Method 1

Browse to the 'Tenancy Menu' and select 'Extensions'. This will take you to the list of extensions.

Select 'Add Extension'.



General Tab

Enter the IMSI number and give an appropriate description (normally the user's name). The extension number to be associated with the IMSI may be manually selected from the remaining unassigned numbers so that a specific extension can be used or it may be auto-assigned whereby the lowest available number is used.

PMX Administrator gives the opportunity to associate two external numbers with the PMX extension. The 'DDI Number' should normally be a public number which points to the gateway connected to the PMX system. The 'External Mobile Network Number' should normally be the mobile number provided by a macro network provider for any SIM card already owned by the user. The user should set a divert on their macro network so that when their phone is not using that network, calls will be forwarded to PMN via the 'DDI Number'. By knowing that these two numbers are associated with the PMX extension, any user on the PMX system dialling either of those two numbers instead of the internal PMX extension number may be routed internally within PMX, thus avoiding call charges on the public network. If the user is not currently on the PMX network, the system can then dial the 'External Mobile Network Number' via the gateway to try to contact the user on the macro network. This also applies to SMS messages so that, when the mobile is not present on the PMX network, any texts can be forwarded to the external mobile number.

Select the user class of service from the profile drop down list:

'Normal Subscriber' is for users who expect to be registered primarily on the PMX network. Such users would issue their external landline number to their callers. PMX will accept calls in from this number and route calls to the PMX extension. If the PMX extension is not registered at the time, the call will be routed to the external mobile number.

'Internal Only' is intended for users who expect to use their macro network mobile number most of the time. Such users would issue their normal mobile number to callers and forward calls to the 'DDI Number' when not present on the macro network. Their normal mobile number would be the primary point of contact with calls routed to PMX if not on the macro network. Calls for these users are then kept 'internal only' on the PMX network i.e. PMX will not dial back out to 'External Mobile Network Number' at any point, either for voice calls or text messages.

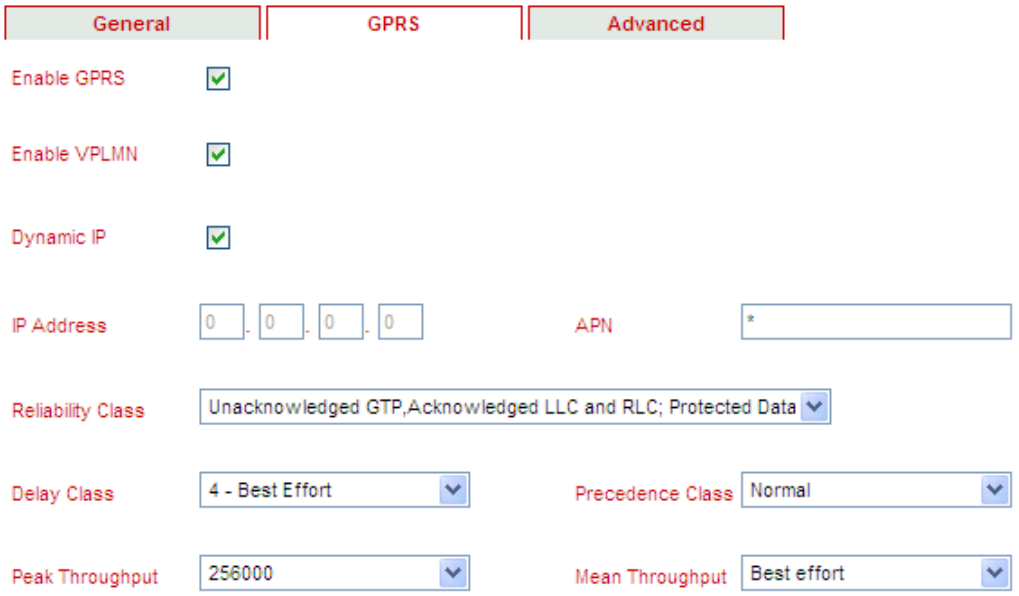
'Emergency Privilege' – the PMX system or individual tenancies may be switched into 'emergency mode' which means that calls on the system are restricted. Whilst in emergency mode, only those users with emergency privilege are allowed to make calls.

Where you are not using the 'Auto-assign Number', the number of extensions listed in the drop-down may be restricted so that, for example, only the first 10 unassigned extension numbers are listed. The value is defined in the web.config file found in [x]:\Program Files\Private Mobile Networks\iMobileNetwork

```
<!-- The max no of entries in a list box -->
        <add key="MaxListCount" value="10" />
```

GPRS Tab

The PMX system can allow GPRS-enabled handsets to access data services. As part of the provisioning process, the relevant settings can be configured on each individual extension.



Enable GPRS
To allow the extension to access GPRS services this box must be ticked. All other settings will be disabled until this is enabled.

Enable VPLMN
Allows an IP address assigned by another network to be used.

Dynamic IP
If ticked, an IP address will automatically assigned to the device. This may change from one registration to the next. When enabled, the 'IP Address' setting which follows will be disabled.

IP Address
Allows a static IP address to be assigned to the extension.

APN
Sets the access point name to be used by the extension. This may be defined as a specific name or, more usually, be set to a value of '*' to allow the device to carry on using their access point settings for macro network GPRS on the PMX network.

Reliability Class
Sets the required level of reliability when sending & receiving GPRS data. The values determine whether sent data should be acknowledged and whether or not the transmission deals with data loss. There is a trade-off between speed and reliability i.e. the faster the transmission, the less the quality of the data can be guaranteed.

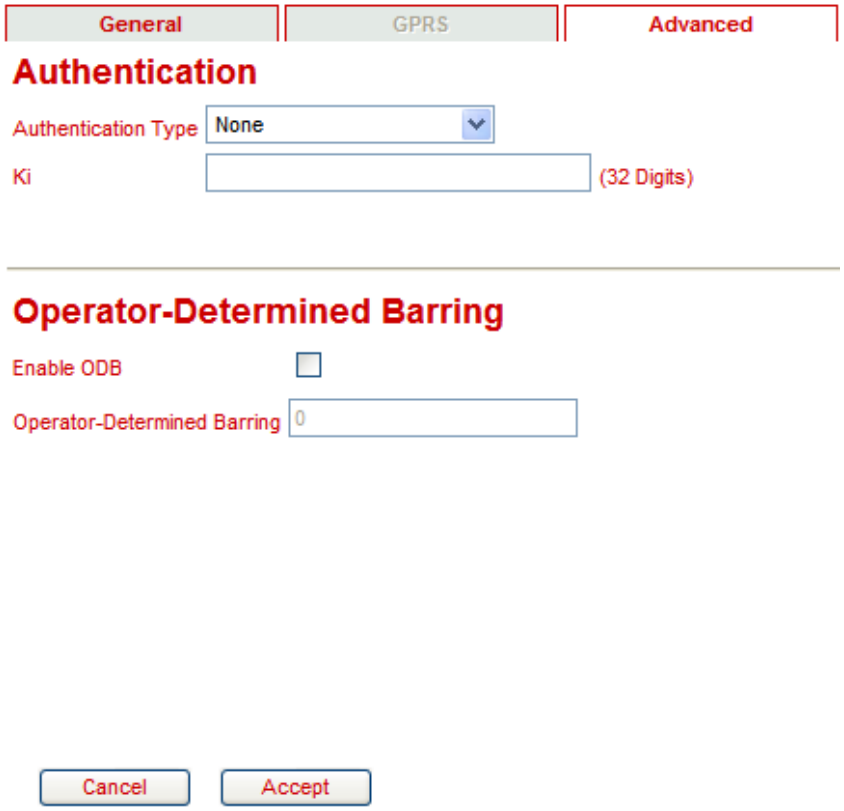
Delay Class
Sets the level of artificial latency on data transmission. If set to 'Best Effort', data will be transmitted as quickly as current network conditions allow.

Precedence Class
Allows the GPRS data for this extension to be given a lower, equal or greater priority than the data of other users.

Peak Throughput
Provides a throttle for the extension's data by setting the fastest rate at which data may be transmitted (measured in bytes per second).

Mean Throughput
Set the maximum amount of data which may be transmitted by the extension (measured in bytes per hour). If set to 'Best Effort', as much data as current network conditions allow will be transmitted.

Advanced Tab



Authentication Type
Sets the algorithm to be used to decrypt the Ki value e.g. 'Milenage' or 'GSM-A'. Such types would be used where the Ki's are held on the PMX system itself. If your system uses SIM's issued by PMN, it is likely that the Ki values will not be divulged to you or held on your system. They will be held centrally by PMN and authentication would take place by means of 'authentication triplets' sent via HTTP. Under this authentication method, your PMX system will request authentication via one of 10 possible HTTP connections whereby a randomly generated number is run through an algorithm and the resultant response from the SIM checked against the result given by the central database. If the values are different, authentication will fail. Where HTTP is used, a Ki value cannot be entered.

Ki
This is a code programmed on the SIM in addition to the IMSI. The Ki can only be determined by means of an algorithm used during a call. The Ki cannot be determined by a card reader and ensures that a ghosted SIM is not being used. For 3rd party SIM's such as those already supplied by a macro network provider, the Ki will be unknown to PMX and authentication will

not be possible. Where the SIM has been supplied by PMN, the Ki will be known and usable as it is programmed by PMN.

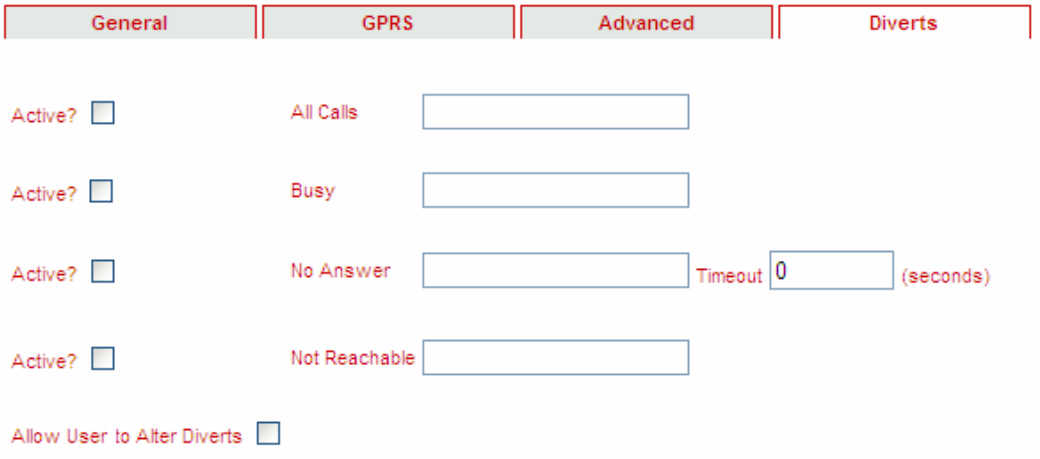
Enable ODB
This sets whether or not Operator-Determined Barring will be used. ODB allows PMX to bar calls from the extension to certain number types such as international or premium rate numbers.

Operator-Determined Barring
The value set in this field is a combined value of the various number types that are either allowed or disallowed. Each combination will give a unique value, which may be entered here.

In most situations, ODB will not be applicable. Barring of calls may be achieved by the PMX routes or by restrictions on the network beyond the PMX gateway. It may be required where the PMX system links up with other network providers under roaming arrangements.

Diverts Tab

As described previously in this document, there may be a requirement to forward / divert calls to other destinations under certain conditions. For example, you may wish to divert calls to a voicemail system or a switchboard if an extension is busy. These diverts may either be set at tenancy level, i.e. all extensions within the tenancy will follow the same diverts or they may be set on individual extensions as described below. Extension diverts will take precedence over tenancy diverts.



Active?
Against each divert type is a tick box labelled ‘Active?’. When ticked, the divert will become active and, when un-ticked, the divert destination will remain but the divert will no longer be active.

All Calls
Otherwise known as an ‘unconditional’ or ‘immediate’ divert, the number defined in this field will be called under all circumstances. This divert, once activated, will take precedence over all other divert types.

Busy
Allows an alternative point of answer to be defined when the extension is busy on another call and no second line is enabled on the extension / handset.

No Answer
Sets an alternative point of answer when calls give no reply within the ringing duration set in ‘Timeout’.

Timeout
Defines the number of seconds the system will wait for an answer from the extension before following the 'No Answer' divert to the defined number.

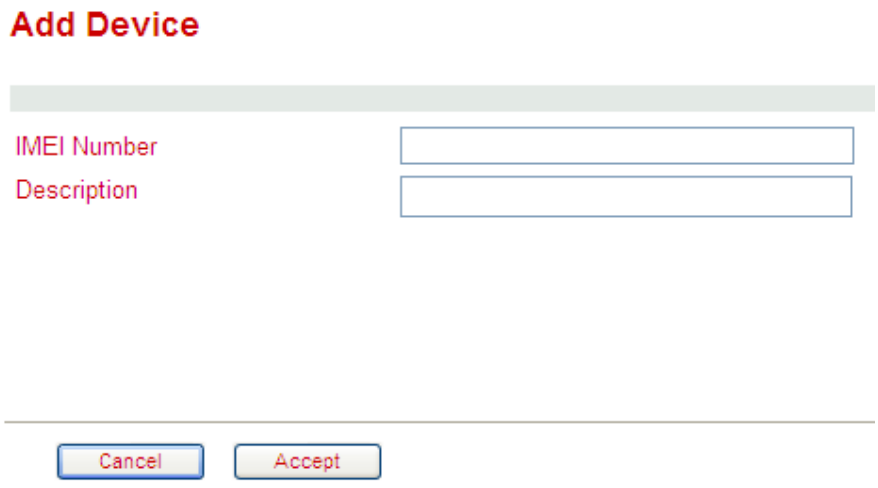
Not Reachable
In circumstances where it can no longer be established that the extension is registered on the system i.e. the handset is switched off, is no longer within range of an access point or has roamed to another network, the system will divert calls to the number defined here.

Allow User to Alter Diverts
The diverts set on this tab may be defined exclusively by the administrator, in which case this box should remain un-ticked, or you may wish to tick the box in order to allow divert commands from the handset to update the divert destinations.

Provisioning Method 2

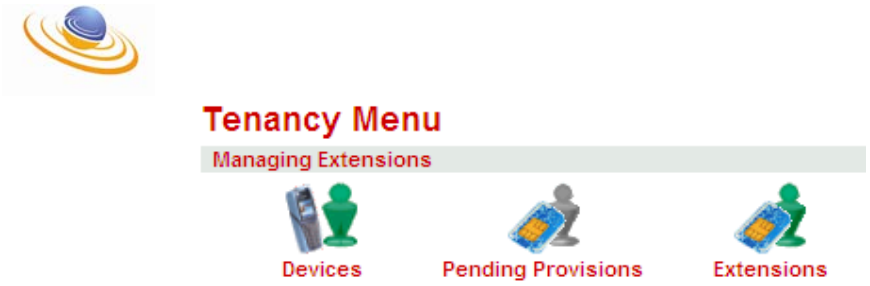
Firstly, you must set up at least one 'device' which is allowed to extension SIM cards onto the network. From the tenancy list, select the tenancy by using either the link on the tenancy ID or name. This will bring you to the 'Tenancy Menu':

Click on the 'Devices' icon and you will be presented with the list of devices. Select 'Add Device'.

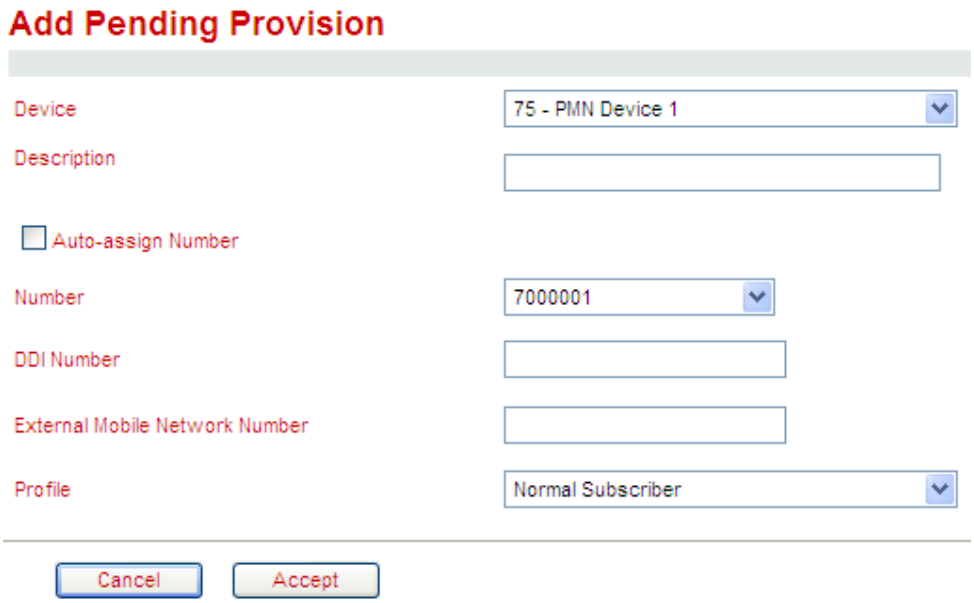


Add the IMEI number for the handset you wish to use in order to provision your SIM cards. The IMEI number is the unique device number for that handset and can be obtained by keying *#06# on the handset itself. A number of 15 or more digits in length will be presented on screen. Enter this number in the IMEI field and give the handset a meaningful description. Click 'Accept' to save the details.

Having added a device capable of provisioning extensions, go back to the 'Tenancy Menu' and click on the 'Pending Provisions' icon.



This will bring you to the list of extension waiting to be provisioned onto the system. Select 'Add Pending Provision' to be taken to the 'Add Pending Provision' screen:



From the device drop-down list, select the device you wish to use, then fill in the rest of the details as per 'Provisioning Method 1'. Repeat this process as many times as necessary to add the extensions required into the pending provisions list.

Once your pending provisions list is complete, place a SIM card into the handset and switch on. If the phone does not automatically find the PMX network, use the handset's menus (consult the handset manual for details) to locate the network provider selection feature and select the network detailed in your network diagram. The SIM card will be provisioned against the first entry in the 'Pending Provisions' list.

Once provisioned, the SIM card will appear in the extensions list and may be removed from the provisioning device and used in any mobile handset.

This process should be repeated until all pending provisions are completed and shown in the extensions list. A careful note should be made of which order the SIM cards were registered so that you know which extension number will have been allocated to each card.

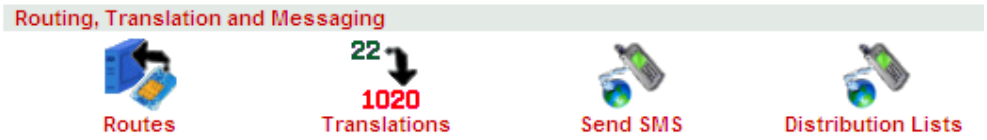
Once configured, a provisioning device may be edited or deleted (once the last extension due to be provisioned by that device has been successfully added).

Once you have created provisions in this manner, you may use the extensions icon to further edit the details of the provision and create GPRS, advanced and divert settings.

SMS Distribution Lists

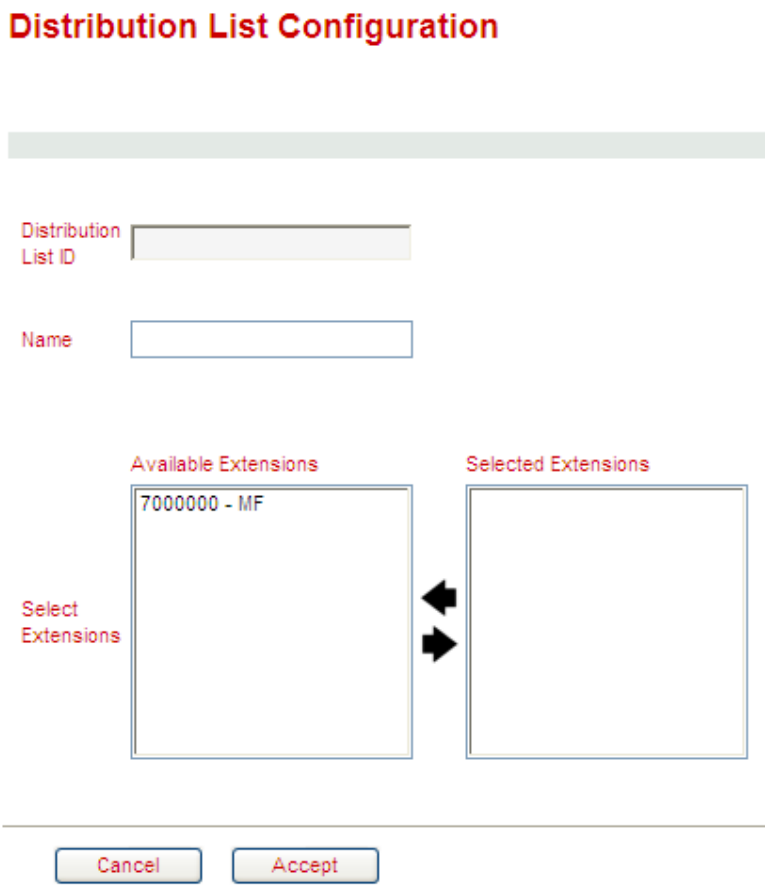
As a PMX system administrator, you may create SMS distribution lists in order to send text messages simultaneously to multiple recipients.

From the tenancy menu, select ‘Distribution Lists’.

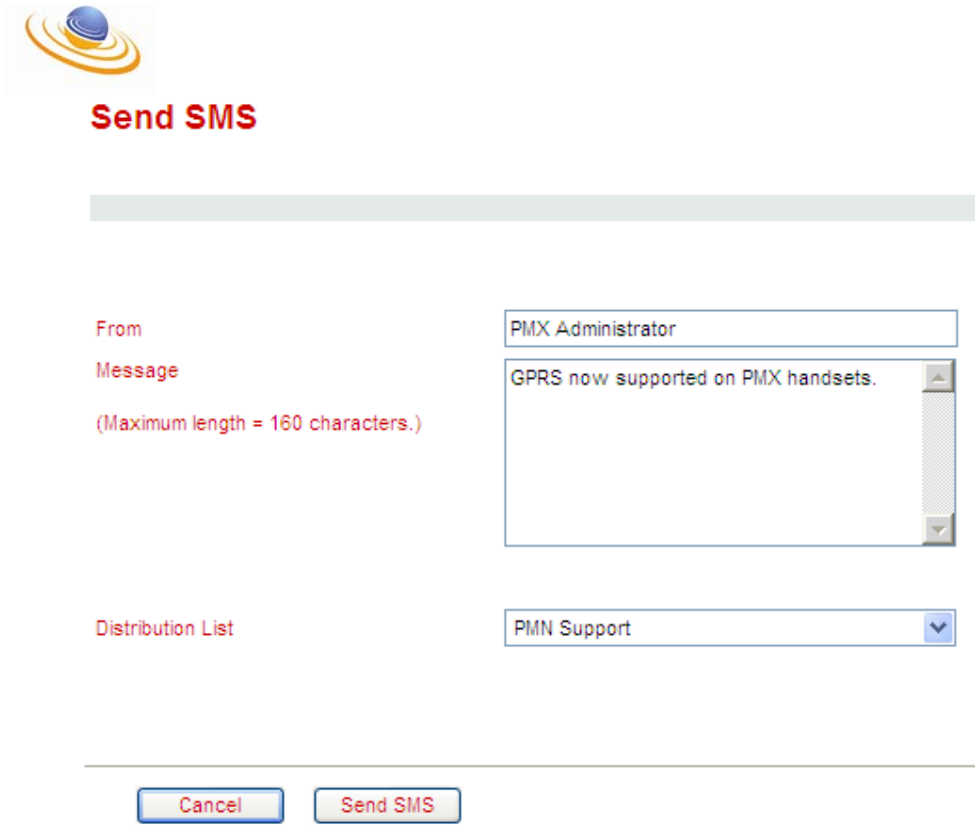


You will be presented with a list of existing Distribution Lists. To create a new list, select ‘Add Distribution List’.

Give the list a suitable name and add the required PMX extensions by highlighting them in the ‘Available Extensions’ list and clicking the right arrow to move them to the ‘Selected Extensions’ list. Click ‘Accept’ to save the list.



Once a list has been configured, you may select the ‘Send SMS’ icon in the ‘Tenancy Menu’.



Enter a value in the ‘SMS From’ field so recipients of the message will know who the originator is. Please note that recipients will not be able to reply to messages sent with a textual value or a number which does not exist. If you do wish recipients to reply to the message, please ensure that you enter a valid PMX extension or macro network mobile number.

Enter the text in the ‘Message’ field, up to a maximum of 160 characters.

Select the appropriate distribution list from the drop-down menu and click ‘Send SMS’.

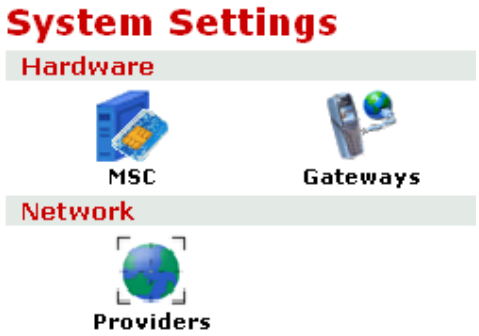
NOTE: It is not possible to add external mobile numbers to distribution lists. Only PMX extensions may be selected, although if a selected handset is “off net” and is on the ‘Normal Subscriber’ profile, the system will attempt to deliver messages to the ‘External Mobile Network Number’ defined against the extension.

Gateways

Although a PMX system may act as a completely self-contained network, most will almost certainly need to receive calls from and make calls to a wider network and the PSTN. In order to achieve this, the system must have a connection to at least one gateway. The gateway will take the SIP messaging used by PMX and relay it to other SIP-enabled devices or convert it to traditional TDM (Time Division Multiplex) protocols such as DPNSS or DASS. The details of any gateway can be added using PMX Administrator and routes assigned to determine which numbers will be placed out via each gateway.

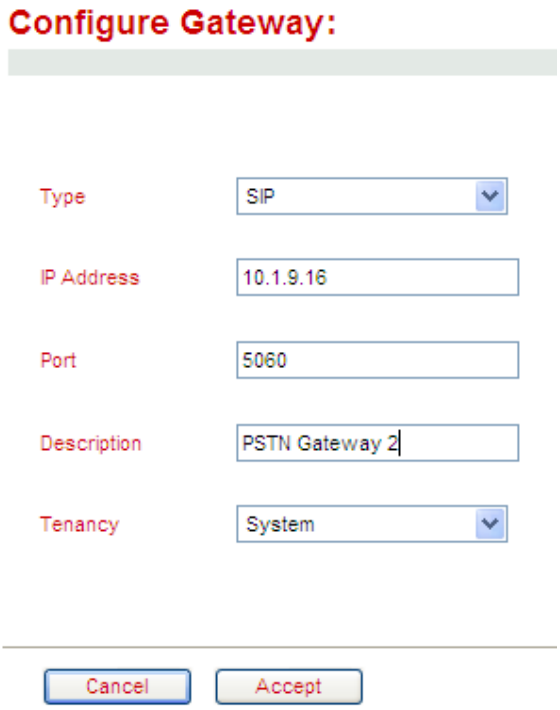
Gateways may be allocated to the system i.e. made available for use by all tenancies, or be assigned for use by one specific tenancy only.

In order to configure a gateway, browse to ‘System Settings’ and follow the ‘Gateways’ link from the ‘System Settings’ menu.



You will be presented with the list of gateways:

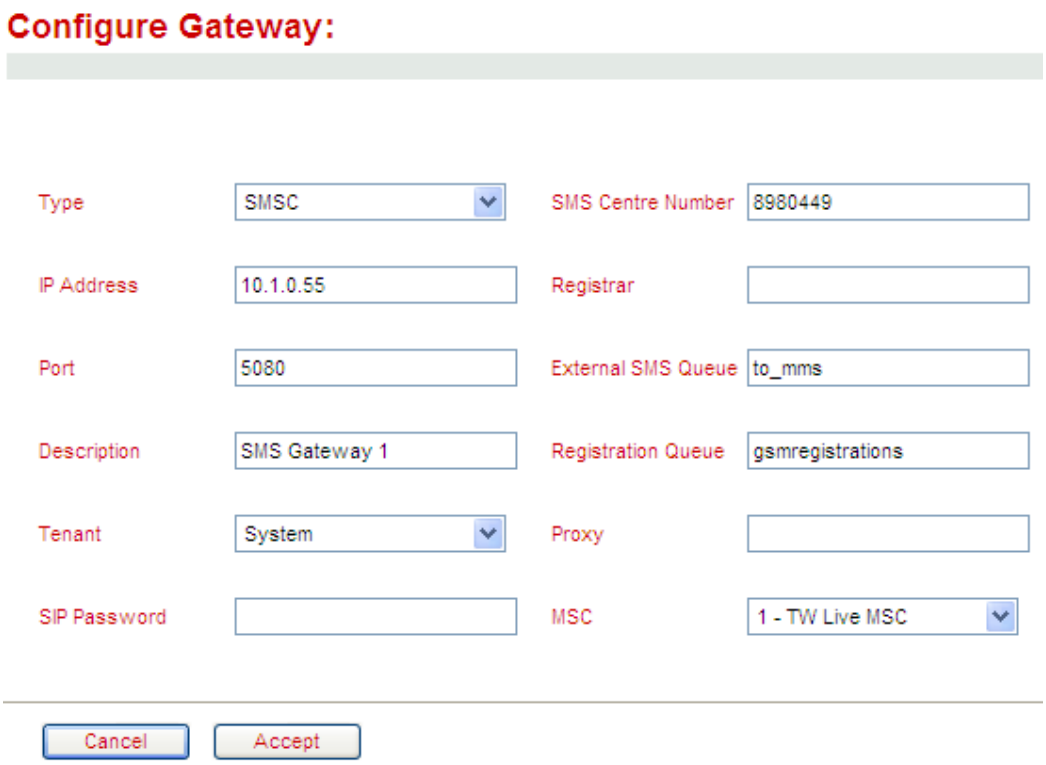
Select ‘Add Gateway’ to be presented with the gateway configuration screen:



The ‘Type’ drop down list offers a choice of SIP and SMSC. Choose SIP for voice calls or SMSC to set the gateway as an SMS Controller. The port number should be set to 5060 for SIP and 5080 for SMSC. These defaults may be changed if required.

The tenancy drop-down list offers a choice between ‘System’ and any existing tenancy names. Select ‘System’ if the gateway is to be used by all tenancies or the appropriate name if only to be available to one tenancy.

If you choose SMSC, you will be presented with a slightly different screen:



On many systems, the fields which are blank in the above screenshot may be left blank as they will not be required. Only where the SMSC needs to register with a call server will the SMS Centre Number (normally 8980449), SIP Password, Registrar and Proxy need to be used in order to register onto the call server.

An IDD field may be seen in some versions of PMX Administrator. Its function is to set the International Dialling Digits for the country where the gateway is located. For example, to dial an international number from the UK, a prefix of 00 is required. The IDD will be used to replace a plus symbol (+) at the front of any dialled number. Later versions do not include the setting as it is automatically handled by the MSC.

The PMX Administrator installation process creates two Microsoft Message Queues:

to_mms is used to deliver text messages to numbers not on PMX.

gsmregistrations is used to store text messages for extensions which are not currently registered on PMX e.g. when the handset is switched off or out of the PMX coverage area. When the handset re-registers with PMX, the queued messages are delivered.

These two queues would normally be defined as shown in the screenshot as these are the standard naming convention. They may be altered if required. If the system is set up to used private instead of public queues, this screen offers the ability to defined the queue names as

.\private$\to_mms

and

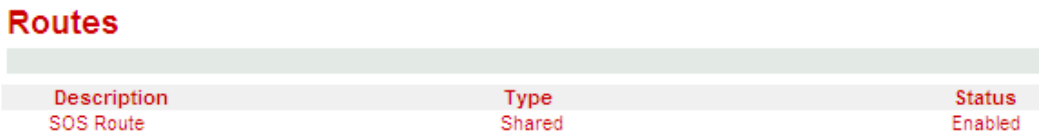
.\private$\gsmregistrations

Routes

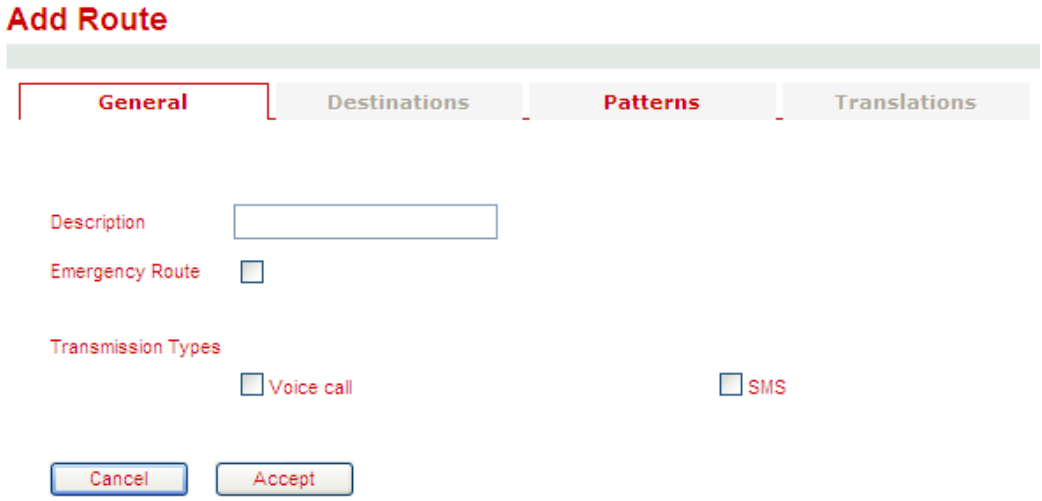
Having created a gateway, you then need to decide which dialled numbers to send to that gateway. When a SIM card is provisioned, you are asked to enter an extension number to be associated with that SIM along with any external number which may also be used in a dual SIM handset. The purpose of the 'External Mobile Network Number' field is twofold. Firstly, PMX will recognise the number and, if dialled by another extension on the PMX system, calls can be routed to the associated handset without breaking out to the PSTN, thus saving on call costs. Secondly, if the associated handset is "off net" we have a secondary means of attempting to contact the user. In order to dial the number on the PSTN, there must be a gateway which provides that connection.

To create a route, browse to the 'Tenancy Menu' and select 'Routes'.

You will be presented with the list of routes:



Click on 'Add Route'.



When creating a route, you will be presented with four main configuration sections. Changes made in any tab may be saved at any time by clicking 'Accept'. You will be returned to the list of routes. Further changes to routes may be made by selecting the one you require from the list.

Description
Allows a meaningful description for the function of the route to be given.

Emergency Route
If ticked, this box will indicate to the system that this route is to be used for routing emergency traffic. Every PMX system is pre-configured with a partially-built ‘SOS Route’ as described earlier in this document so normally there is no need to add further routes for emergency traffic. In most case, the box will remain un-ticked so that the route will handle ‘ordinary’ traffic.

Transmission Types
Simply tick the box for each type of transmission you wish to send along this route. Predominantly, ‘Voice call’ will be the preferred option.

Destinations Tab

This allows you to decide where calls following this route will be sent. You may add a single or multiple gateways (or extensions if required). Where multiple gateways are selected, PMX will evenly load balance calls between all destinations. It may be appropriate to send calls to particular numbers out via a certain gateway. For example, if one gateway has a connection to an LCR (Least Cost Router) device, you may wish to send calls to 07 numbers via this gateway to take advantage of lower call costs to the PSTN.

Click on the ‘Destinations’ tab to see the list of destinations.

Click on ‘Add Destination’ to select from the list of available gateways / extensions.

Patterns Tab

Patterns are the numbers or number prefixes PMX will try to match in order to determine that this route should be followed. The pattern with the closest match to the dialled number will be used. Patterns may be built up using wild card characters and numbers in brackets. Some examples are given below:

01845521000 This being a fully-defined number, PMX will look for an exact match.

07$ Any number beginning 07, regardless of the number of digits following this prefix.

0[12]XXXXXXXXX Any number beginning 01 or 02 followed by 9 digits of any value (each X represents one digit of any value).

0[7-9]XXXXXXXXX Any number beginning 07, 08 or 09 followed by nine digits of any value.

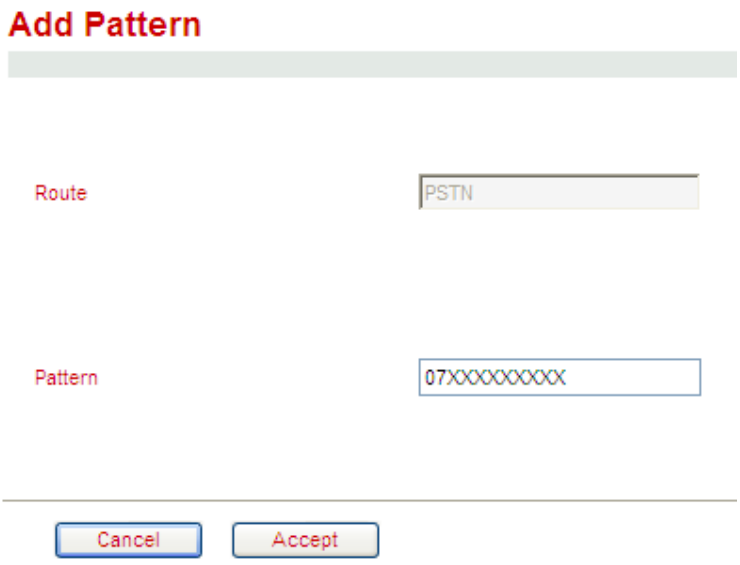
90$ Any number beginning 90. You may wish to include patterns which cater for anyone who puts a standard outside line prefix of 9 on the number. However, it is unlikely that this will be required as mobile phone users never need to use an outside line prefix in any other mobile environment.

D Any single character from 0 to 9 inclusive.

N Any single character from 1 to 9 inclusive.

Click on the 'Patterns' tab to see the list of patterns.

Click on 'Add Pattern' to define the dialled numbers which are to follow this route. Repeat as required.

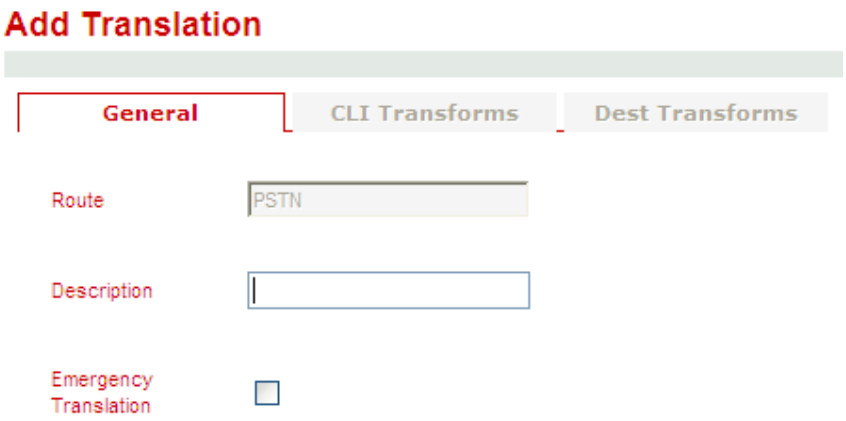


Translations Tab

Translations are made up of two component parts, each referred to as a ‘transform’. These are the ‘CLI Transform’ and the ‘Destination Transform’.

Click on the ‘Translations’ tab to see the list of translations.

Click on ‘Add Translation’ to be presented with the ‘General’ tab for the translation where you may give the translation a meaningful description and state whether the translation is to be applied as part of an emergency route.



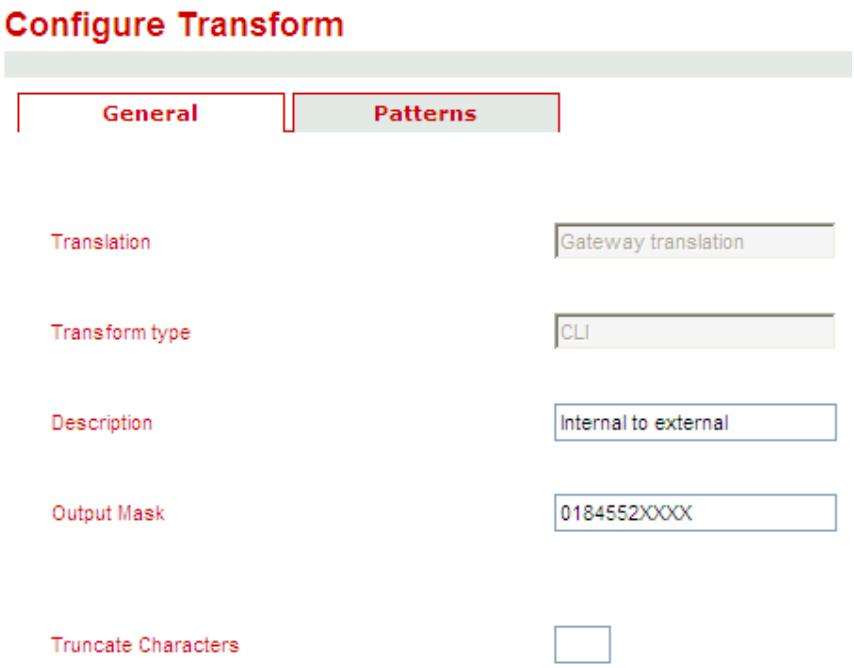
CLI Transforms

When passing out calls to a gateway, it may be necessary to modify the CLI of the calling extension to a number more appropriate to the recipient of the call. Ordinarily, calls between PMX extensions would display the extension number. When dialling to a number on the PSTN, the extension number is not appropriate so the CLI may be modified so that the ‘DDI Number’ for the calling extension is delivered. The CLI transform can be given a meaningful description and an ‘output mask’. The output mask uses the same construction method as patterns.

To take a practical example, an internal number of 78002 has a DDI of 01845528002 associated with it. The output mask would be 0184552XXXX . The four X’s tell PMX to output a CLI of 0184552 followed by the last four digits of the extension number.

Click on the ‘CLI Transforms’ tab so see the list of CLI transforms.

Click on ‘Add CLI Transform’ to create a description and output mask:



The output mask may take values from the configured patterns based on two wild card character types:

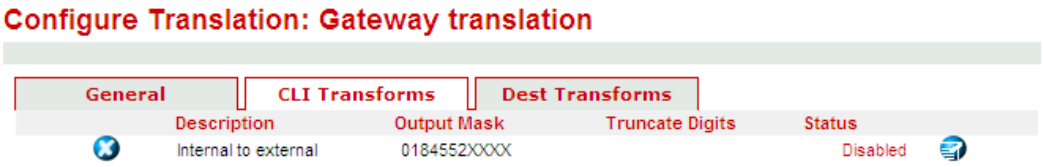
X or _ - by entering an X or an underscore, the output mask (as shown in the screenshot above) will use any literal value and suffix it with digits taken from the pattern. In this example, a prefix of 0184552 will be used and the last four digits of the output number will be the last four digits derived from the number on the pattern. So, if the CLI is 78123 the output will be 01845528123.

$ - entering the dollar wild card in the output mask brings the “Truncate Characters” function into play. Instead of taking the set number of characters from the end of the pattern (as in the example above), truncating the pattern means that a set number of characters from the beginning of a pattern will be dropped. So, if this transform were to allow patterns of differing lengths but where the prefix was the same, the prefix could be removed without the need to define separate transforms. For example, patterns of 78XXXXXX and 78XXXXXXX may be allowed on the transform and you wish to output the number minus the “78” prefix, regardless of how many digits follow. Defining an output mask of 0845$ with a value of “2” in Truncate Characters will cause the “78” to be dropped and the output will be 0845 followed by a 6 or 7-digit number.

Entering a dollar in the output mask without a value in ‘Truncate Characters’ (or vice versa) will generate an error message.

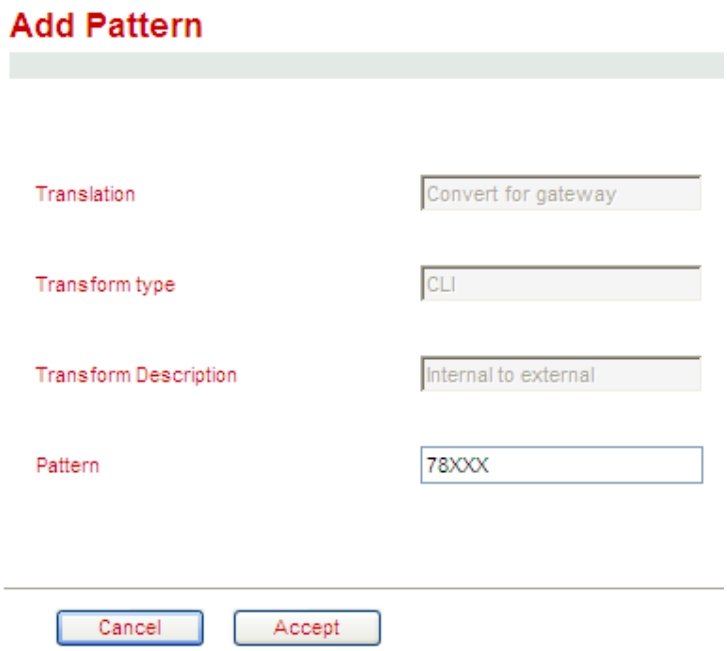
N.B. The dollar wild card only has this function in an output mask. On a pattern, the dollar will still denote any number of characters of any value.

Click ‘Accept’ to save the transform and return to the list of CLI transforms. From the list, click the ‘Configure’ icon to continue entering details.

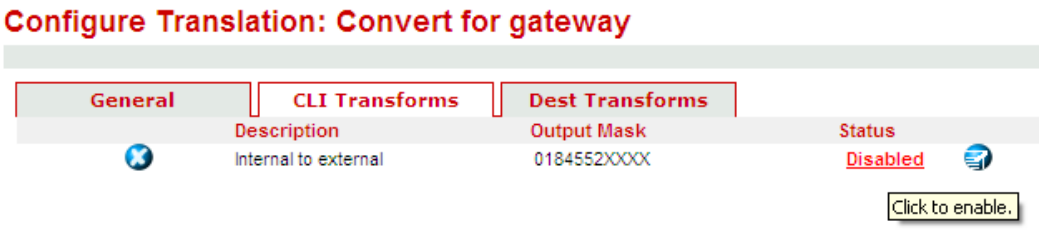


Click the ‘Patterns’ tab to see the list of patterns for the CLI transform.

Click on ‘Add Pattern’ to determine which extension CLI’s need to be modified:



Once configured, the CLI transform must be enabled to take effect:



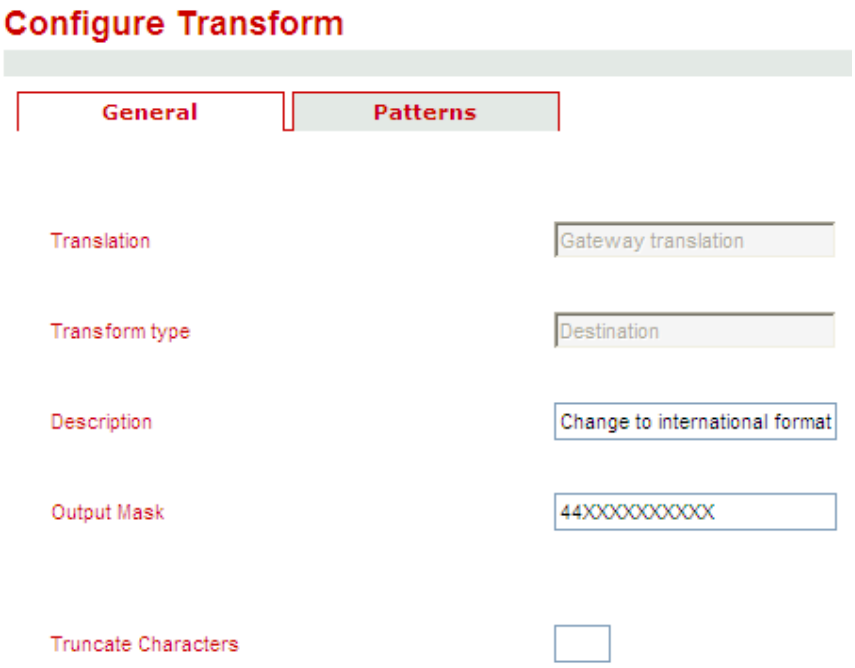
NOTE : Telecoms regulations in the country or countries where the system is to operate may restrict the CLI you are able to deliver to the PSTN. Only ‘trusted’ E1 or T1 links may be allowed to deliver any chosen CLI.

Destination Transform

The purpose of this transform is to modify the dialled number into any alternative form as required by the gateway. For example, the gateway may be required to dial external numbers using international number format e.g. 441845528002 when the user has dialled 01845528002. As with the CLI transform, an output mask is required. In the example above, the mask would be 44XXXXXXXXX (10 X's) so that the number dialled by the gateway would be '44' followed by the last 10 digits of the number entered by the caller. PMX therefore adds '44' and drops the leading zero. Not only is an output mask required but we need to know when to apply that mask. Therefore, at least one pattern is also required. In this case, the pattern applies to the calling extension numbers i.e. when PMX sees a call from extensions matching the pattern, the destination transform will be applied. Where PMX extensions are in the range 78000 to 78999, a pattern of 78XXX (3 X's) could be applied so that calls from any extension in the 78xxx range would use the transform.

Click on the 'Dest Transforms' tab to see the list of destination transforms.

Click on 'Add Destination Transform' to create a description and output mask (including 'Truncate Characters' rule if required):



The output mask may take values from the configured patterns based on two wild card character types:

X or _ - by entering an X or an underscore, the output mask (as shown in the screenshot above) will use any literal value and suffix it with digits taken from the pattern. In this example, a prefix of "44" will be used and the last ten digits of the output number will be the last ten digits derived from the number on the pattern. So, if the destination is "01845528100" the output will be "441845528100".

$ - entering the dollar wild card in the output mask brings the "Truncate Characters" function into play. Instead of taking the set number of characters from the end of the pattern (as in the example above), truncating the pattern means that a set number of characters from the beginning of a pattern will be dropped. So, if this transform were to allow patterns of differing lengths but where the prefix was the same, the prefix could be removed without the need to define separate transforms. For example, patterns of "0XXXXXXXXX" and "0XXXXXXXXXX"

may be allowed on the transform and you wish to output “44” plus the dialed number minus the “0” prefix, regardless of how many digits follow. Defining an output mask of 0$ with a value of “1” in Truncate Characters will cause the “0” to be dropped and the output will be “44” followed by a 9 or 10-digit number.

Entering a dollar in the output mask without a value in ‘Truncate Characters’ (or vice versa) will generate an error message.

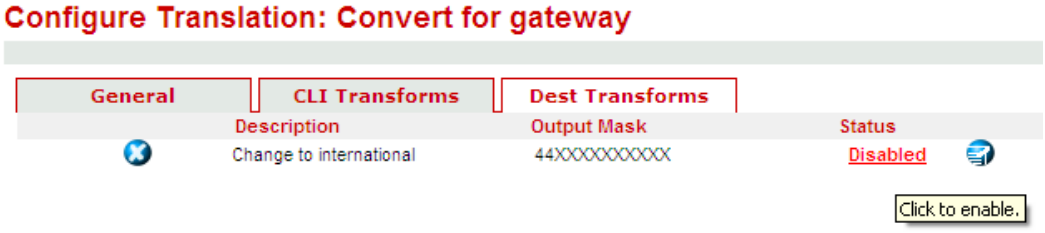
N.B. The dollar wild card only has this function in an output mask. On a pattern, the dollar will still denote any number of characters of any value.

Click ‘Accept’ to save the transform and return to the list of CLI transforms. From the list, click the ‘Configure’ icon to continue entering details.

Click the ‘Patterns’ tab to see the list of patterns for the destination transform.

Click on ‘Add Pattern’ to define the dialled numbers which will be transformed:

Once configured, each transform must be enabled for it to take effect.



The route itself must then also be enabled for all its components to come into effect.

Tenancy Translations

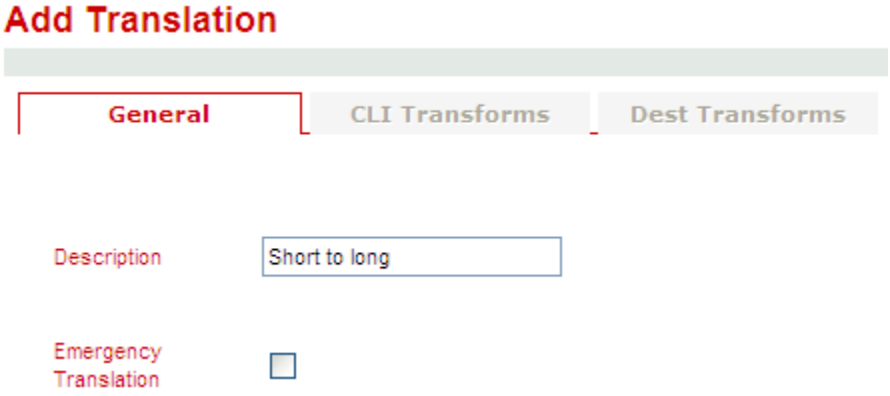
In addition to the translations applied against a route, PMX allows translations to be configured against internal numbers. In this case, the destination is assumed be an extension number not a gateway, so no destination can be specified. A practical example of a tenancy translation is where the gateway presents calls to PMX with the destination digits in a format not matching the extension number scheme e.g. with a network node prefix. A translation would be required to remove the prefix from the received digits to match them to a number in the tenancy's ranges.

Another example would be where you wish to use a long number for your extensions but allow users to dial a shortened version of that number for ease of use.

To create a tenancy translation, browse to the 'Tenancy Menu' and select 'Translations'.

You will be presented with the list of translations:

Click on 'Add Translation' to create a description and flag as an emergency translation if required:

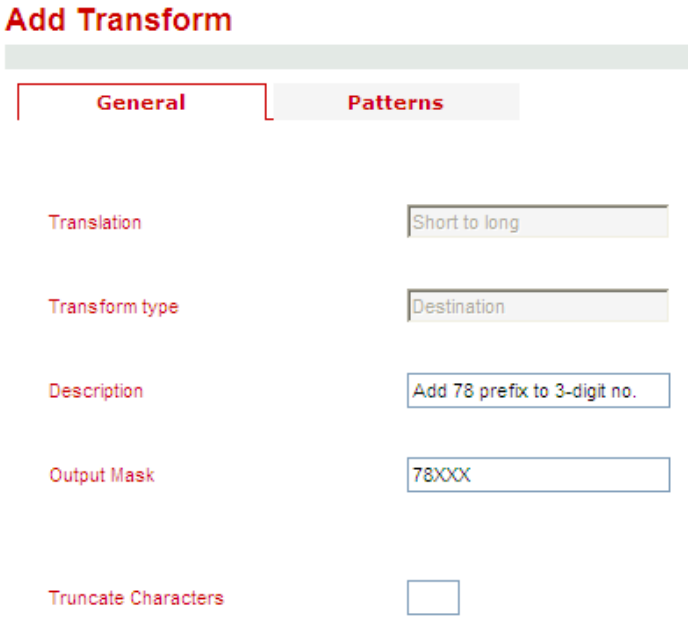


Click 'Accept' to create the translation and drop back to the list of extensions.

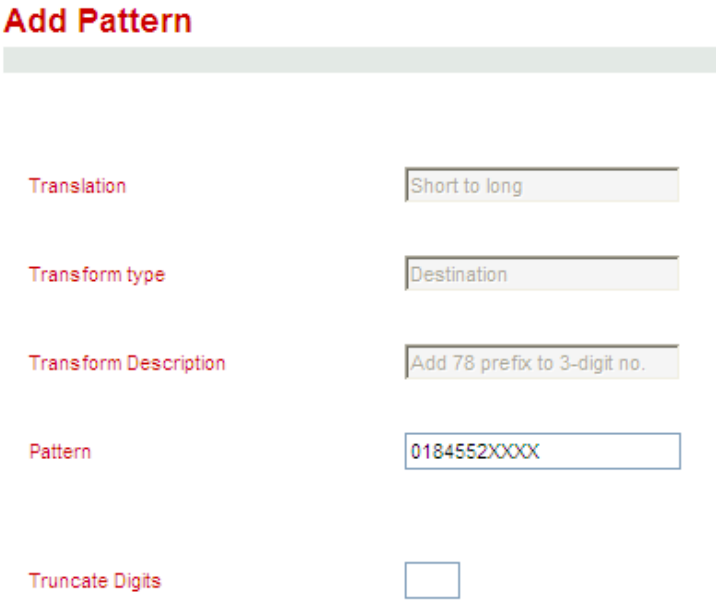
Select the translation from the list to continue configuring details.

In this example, no CLI transform is required because calls will be routed within PMX. Therefore, the internal extension number is valid as the CLI to present.

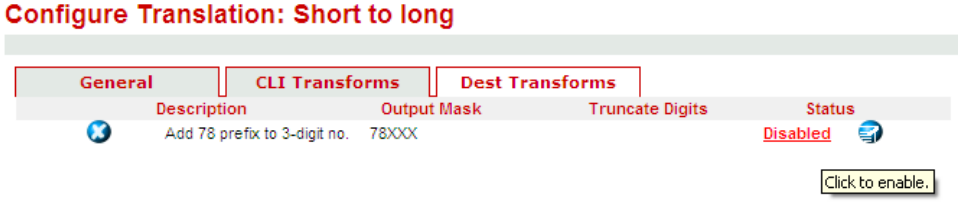
Click on 'Add Destination Transform' to add a description and output mask (with a 'Truncate Characters rule defined, if required):



Click on 'Add a Pattern' to determine which dialled numbers should be modified by the transform:



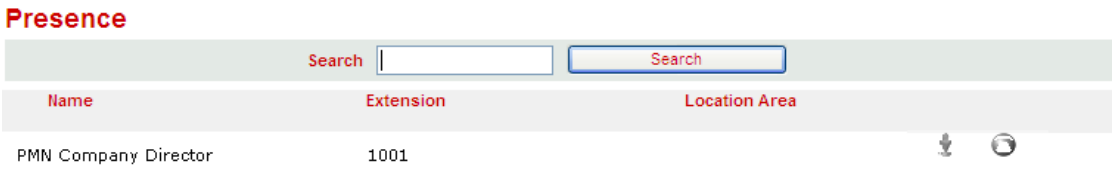
The transform must then be enabled to take effect:



Presence

Each extension will appear in a list of provisioned numbers within the selected tenancy. The list is accessible via the 'Tenancy Menu' by clicking on the 'Presence' icon.

You will be presented with the following screen:



The list may be sorted by any of the column headings or may be filtered by searching on the selected column heading (indicated by two asterisks).

The LA column will show which Location Area the user is currently in.

The first icon indicates the extension's current subscription status. A grey icon means that the user is not currently on the network. When on the PMX network, the icon will be green.

The second icon indicates the extension's current call status. A grey icon means that the user is not on the network and therefore not on a call. When the user is on the network but not in call, the icon will be blue. When on a call, the icon will be pink.

Please note that this screen does not update in real time. To get the most up-to-date view, click the refresh button.

Appendix D - I/O Connector Pinouts

Ethernet Port

There is one (1) Ethernet port on the Laptop and one on each of the BTSs.

Pin	Wire Color	Signal
1	White Orange	TX+
2	Orange	TX-
3	White Green	RX+
4	Blue	POE
5	White Blue	POE
6	Green	RX-
7	White Brown	POE
8	Brown	POE

Ethernet Cable Pin Outs “Cross Over Cable”

Below is a pin for an Ethernet cross over cable. No Pin Out is provided for a straight through cable, because it is simply straight through.

Connector 1		Connector 2
Pin 1	→	Pin 3
Pin 2	→	Pin 6
Pin 3	→	Pin 1
Pin 4	→	Pin 4
Pin 5	→	Pin 5
Pin 6	→	Pin 2
Pin 7	→	Pin 7
Pin 8	→	Pin 8

Appendix E - dBm-to-Watts Conversion Table

dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts
20.0	0.100	25.0	0.316	30.0	1.00	35.0	3.16	40.0	10.00	45.0	31.62	50.0	100.00	55.0	316.23	60.0	1000.00
20.1	0.102	25.1	0.324	30.1	1.02	35.1	3.24	40.1	10.23	45.1	32.36	50.1	102.33	55.1	323.59	60.1	1023.29
20.2	0.105	25.2	0.331	30.2	1.05	35.2	3.31	40.2	10.47	45.2	33.11	50.2	104.71	55.2	331.13	60.2	1047.13
20.3	0.107	25.3	0.339	30.3	1.07	35.3	3.39	40.3	10.72	45.3	33.88	50.3	107.15	55.3	338.84	60.3	1071.52
20.4	0.110	25.4	0.347	30.4	1.10	35.4	3.47	40.4	10.96	45.4	34.67	50.4	109.65	55.4	346.74	60.4	1096.48
20.5	0.112	25.5	0.355	30.5	1.12	35.5	3.55	40.5	11.22	45.5	35.48	50.5	112.20	55.5	354.81	60.5	1122.02
20.6	0.115	25.6	0.363	30.6	1.15	35.6	3.63	40.6	11.48	45.6	36.31	50.6	114.82	55.6	363.08	60.6	1148.15
20.7	0.117	25.7	0.372	30.7	1.17	35.7	3.72	40.7	11.75	45.7	37.15	50.7	117.49	55.7	371.54	60.7	1174.90
20.8	0.120	25.8	0.380	30.8	1.20	35.8	3.80	40.8	12.02	45.8	38.02	50.8	120.23	55.8	380.19	60.8	1202.26
20.9	0.123	25.9	0.389	30.9	1.23	35.9	3.89	40.9	12.30	45.9	38.90	50.9	123.03	55.9	389.05	60.9	1230.27
21.0	0.126	26.0	0.398	31.0	1.26	36.0	3.98	41.0	12.59	46.0	39.81	51.0	125.89	56.0	398.11	61.0	1258.93
21.1	0.129	26.1	0.407	31.1	1.29	36.1	4.07	41.1	12.88	46.1	40.74	51.1	128.82	56.1	407.38	61.1	1288.25
21.2	0.132	26.2	0.417	31.2	1.32	36.2	4.17	41.2	13.18	46.2	41.69	51.2	131.83	56.2	416.87	61.2	1318.26
21.3	0.135	26.3	0.427	31.3	1.35	36.3	4.27	41.3	13.49	46.3	42.66	51.3	134.90	56.3	426.58	61.3	1348.96
21.4	0.138	26.4	0.437	31.4	1.38	36.4	4.37	41.4	13.80	46.4	43.65	51.4	138.04	56.4	436.52	61.4	1380.38
21.5	0.141	26.5	0.447	31.5	1.41	36.5	4.47	41.5	14.13	46.5	44.67	51.5	141.25	56.5	446.68	61.5	1412.54
21.6	0.145	26.6	0.457	31.6	1.45	36.6	4.57	41.6	14.45	46.6	45.71	51.6	144.54	56.6	457.09	61.6	1445.44
21.7	0.148	26.7	0.468	31.7	1.48	36.7	4.68	41.7	14.79	46.7	46.77	51.7	147.91	56.7	467.74	61.7	1479.11
21.8	0.151	26.8	0.479	31.8	1.51	36.8	4.79	41.8	15.14	46.8	47.86	51.8	151.36	56.8	478.63	61.8	1513.56
21.9	0.155	26.9	0.490	31.9	1.55	36.9	4.90	41.9	15.49	46.9	48.98	51.9	154.88	56.9	489.78	61.9	1548.82
22.0	0.158	27.0	0.501	32.0	1.58	37.0	5.01	42.0	15.85	47.0	50.12	52.0	158.49	57.0	501.19	62.0	1584.89
22.1	0.162	27.1	0.513	32.1	1.62	37.1	5.13	42.1	16.22	47.1	51.29	52.1	162.18	57.1	512.86	62.1	1621.81
22.2	0.166	27.2	0.525	32.2	1.66	37.2	5.25	42.2	16.60	47.2	52.48	52.2	165.96	57.2	524.81	62.2	1659.59
22.3	0.170	27.3	0.537	32.3	1.70	37.3	5.37	42.3	16.98	47.3	53.70	52.3	169.82	57.3	537.03	62.3	1698.24
22.4	0.174	27.4	0.550	32.4	1.74	37.4	5.50	42.4	17.38	47.4	54.95	52.4	173.78	57.4	549.54	62.4	1737.80
22.5	0.178	27.5	0.562	32.5	1.78	37.5	5.62	42.5	17.78	47.5	56.23	52.5	177.83	57.5	562.34	62.5	1778.28
22.6	0.182	27.6	0.575	32.6	1.82	37.6	5.75	42.6	18.20	47.6	57.54	52.6	181.97	57.6	575.44	62.6	1819.70
22.7	0.186	27.7	0.589	32.7	1.86	37.7	5.89	42.7	18.62	47.7	58.88	52.7	186.21	57.7	588.84	62.7	1862.09
22.8	0.191	27.8	0.603	32.8	1.91	37.8	6.03	42.8	19.05	47.8	60.26	52.8	190.55	57.8	602.56	62.8	1905.46
22.9	0.195	27.9	0.617	32.9	1.95	37.9	6.17	42.9	19.50	47.9	61.66	52.9	194.98	57.9	616.60	62.9	1949.84
23.0	0.200	28.0	0.631	33.0	2.00	38.0	6.31	43.0	19.95	48.0	63.10	53.0	199.53	58.0	630.96	63.0	1995.26
23.1	0.204	28.1	0.646	33.1	2.04	38.1	6.46	43.1	20.42	48.1	64.57	53.1	204.17	58.1	645.65	63.1	2041.74
23.2	0.209	28.2	0.661	33.2	2.09	38.2	6.61	43.2	20.89	48.2	66.07	53.2	208.93	58.2	660.69	63.2	2089.30
23.3	0.214	28.3	0.676	33.3	2.14	38.3	6.76	43.3	21.38	48.3	67.61	53.3	213.80	58.3	676.08	63.3	2137.96
23.4	0.219	28.4	0.692	33.4	2.19	38.4	6.92	43.4	21.88	48.4	69.18	53.4	218.78	58.4	691.83	63.4	2187.76
23.5	0.224	28.5	0.708	33.5	2.24	38.5	7.08	43.5	22.39	48.5	70.79	53.5	223.87	58.5	707.95	63.5	2238.72
23.6	0.229	28.6	0.724	33.6	2.29	38.6	7.24	43.6	22.91	48.6	72.44	53.6	229.09	58.6	724.44	63.6	2290.87
23.7	0.234	28.7	0.741	33.7	2.34	38.7	7.41	43.7	23.44	48.7	74.13	53.7	234.42	58.7	741.31	63.7	2344.23
23.8	0.240	28.8	0.759	33.8	2.40	38.8	7.59	43.8	23.99	48.8	75.86	53.8	239.88	58.8	758.58	63.8	2398.83
23.9	0.245	28.9	0.776	33.9	2.45	38.9	7.76	43.9	24.55	48.9	77.62	53.9	245.47	58.9	776.25	63.9	2454.71
24.0	0.251	29.0	0.794	34.0	2.51	39.0	7.94	44.0	25.12	49.0	79.43	54.0	251.19	59.0	794.33	64.0	2511.89

dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm	Watts
24.1	0.257	29.1	0.813	34.1	2.57	39.1	8.13	44.1	25.70	49.1	81.28	54.1	257.04	59.1	812.83	64.1	2570.40
24.2	0.263	29.2	0.832	34.2	2.63	39.2	8.32	44.2	26.30	49.2	83.18	54.2	263.03	59.2	831.76	64.2	2630.27
24.3	0.269	29.3	0.851	34.3	2.69	39.3	8.51	44.3	26.92	49.3	85.11	54.3	269.15	59.3	851.14	64.3	2691.53
24.4	0.275	29.4	0.871	34.4	2.75	39.4	8.71	44.4	27.54	49.4	87.10	54.4	275.42	59.4	870.96	64.4	2754.23
24.5	0.282	29.5	0.891	34.5	2.82	39.5	8.91	44.5	28.18	49.5	89.13	54.5	281.84	59.5	891.25	64.5	2818.38
24.6	0.288	29.6	0.912	34.6	2.88	39.6	9.12	44.6	28.84	49.6	91.20	54.6	288.40	59.6	912.01	64.6	2884.03
24.7	0.295	29.7	0.933	34.7	2.95	39.7	9.33	44.7	29.51	49.7	93.33	54.7	295.12	59.7	933.25	64.7	2951.21
24.8	0.302	29.8	0.955	34.8	3.02	39.8	9.55	44.8	30.20	49.8	95.50	54.8	302.00	59.8	954.99	64.8	3019.95
24.9	0.309	29.9	0.977	34.9	3.09	39.9	9.77	44.9	30.90	49.9	97.72	54.9	309.03	59.9	977.24	64.9	3090.30

Appendix F - ARFCN Frequencies

F-1. GSM-850 ARFCN Frequencies (in MHz)

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
128	824.200	869.200	166	831.800	876.800	204	839.400	884.400
129	824.400	869.400	167	832.000	877.000	205	839.600	884.600
130	824.600	869.600	168	832.200	877.200	206	839.800	884.800
131	824.800	869.800	169	832.400	877.400	207	840.000	885.000
132	825.000	870.000	170	832.600	877.600	208	840.200	885.200
133	825.200	870.200	171	832.800	877.800	208	840.400	885.400
134	825.400	870.400	172	833.000	878.000	210	840.600	885.600
135	825.600	870.600	173	833.200	878.200	211	840.800	885.800
136	825.800	870.800	174	833.400	878.400	212	841.000	886.000
137	826.000	871.000	175	833.600	878.600	213	841.200	886.200
138	826.200	871.200	176	833.800	878.800	214	841.400	886.400
139	826.400	871.400	177	834.000	879.000	215	841.600	886.600
140	826.600	871.600	178	834.200	879.200	216	841.800	886.800
141	826.800	871.800	179	834.400	879.400	217	842.000	887.000
142	827.000	872.000	180	834.600	879.600	218	842.200	887.200
143	827.200	872.200	181	834.800	879.800	219	842.400	887.400
144	827.400	872.400	182	835.000	880.000	220	842.600	887.600
145	827.600	872.600	183	835.200	880.200	221	842.800	887.800
146	827.800	872.800	184	835.400	880.400	222	843.000	888.000
147	828.000	873.000	185	835.600	880.600	223	843.200	888.200
148	828.200	873.200	186	835.800	880.800	224	843.400	888.400
149	828.400	873.400	187	836.000	881.000	225	843.600	888.600
150	828.600	873.600	188	836.200	881.200	226	843.800	888.800
151	828.800	873.800	189	836.400	881.400	227	844.000	889.000
152	829.000	874.000	190	836.600	881.600	228	844.200	889.200
153	829.200	874.200	191	836.800	881.800	229	844.400	889.400
154	829.400	874.400	192	837.000	882.000	230	844.600	889.600
155	829.600	874.600	193	837.200	882.200	231	844.800	889.800
156	829.800	874.800	194	837.400	882.400	232	845.000	890.000
157	830.000	875.000	195	837.600	882.600	233	845.200	890.200
158	830.200	875.200	196	837.800	882.800	234	845.400	890.400
159	830.400	875.400	197	838.000	883.000	235	845.600	890.600
160	830.600	875.600	198	838.200	883.200	236	845.800	890.800
161	830.800	875.800	199	838.400	883.400	237	846.000	891.000
162	831.000	876.000	200	838.600	883.600	238	846.200	891.200
163	831.200	876.200	201	838.800	883.800	239	846.400	891.400
164	831.400	876.400	202	839.000	884.000	240	846.600	891.600
165	831.600	876.600	203	839.200	884.200	241	846.800	891.800
242	847.000	892.000	246	847.800	892.800	250	848.600	893.600
243	847.200	892.200	247	848.000	893.000	251	848.800	893.800

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
244	847.400	892.400	248	848.200	893.200	251	847.000	892.000
245	847.600	892.600	249	848.400	893.400	---	---	---

F-2. E-GSM-900 ARFCN Frequencies (in MHz)

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
0	890.000	935.000	30	896.000	941.000	60	902.000	947.000
1	890.200	935.200	31	896.200	941.200	61	902.200	947.200
2	890.400	935.400	32	896.400	941.400	62	902.400	947.400
3	890.600	935.600	33	896.600	941.600	63	902.600	947.600
4	890.800	935.800	34	896.800	941.800	64	902.800	947.800
5	891.000	936.000	35	897.000	942.000	65	903.000	948.000
6	891.200	936.200	36	897.200	942.200	66	903.200	948.200
7	891.400	936.400	37	897.400	942.400	67	903.400	948.400
8	891.600	936.600	38	897.600	942.600	68	903.600	948.600
9	891.800	936.800	39	897.800	942.800	69	903.800	948.800
10	892.000	937.000	40	898.000	943.000	70	904.000	949.000
11	892.200	937.200	41	898.200	943.200	71	904.200	949.200
12	892.400	937.400	42	898.400	943.400	72	904.400	949.400
13	892.600	937.600	43	898.600	943.600	73	904.600	949.600
14	892.800	937.800	44	898.800	943.800	74	904.800	949.800
15	893.000	938.000	45	899.000	944.000	75	905.000	950.000
16	893.200	938.200	46	899.200	944.200	76	905.200	950.200
17	893.400	938.400	47	899.400	944.400	77	905.400	950.400
18	893.600	938.600	48	899.600	944.600	78	905.600	950.600
19	893.800	938.800	49	899.800	944.800	79	905.800	950.800
20	894.000	939.000	50	900.000	945.000	80	906.000	951.000
21	894.200	939.200	51	900.200	945.200	81	906.200	951.200
22	894.400	939.400	52	900.400	945.400	82	906.400	951.400
23	894.600	939.600	53	900.600	945.600	83	906.600	951.600
24	894.800	939.800	54	900.800	945.800	84	906.800	951.800
25	895.000	940.000	55	901.000	946.000	85	907.000	952.000
26	895.200	940.200	56	901.200	946.200	86	907.200	952.200
27	895.400	940.400	57	901.400	946.400	87	907.400	952.400
28	895.600	940.600	58	901.600	946.600	88	907.600	952.600
29	895.800	940.800	59	901.800	946.800	89	907.800	952.800
						90	908.000	953.000

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
91	908.200	953.200	103	910.600	955.600	115	913.000	958.000
92	908.400	953.400	104	910.800	955.800	116	913.200	958.200
93	908.600	953.600	105	911.000	956.000	117	913.400	958.400
94	908.800	953.800	106	911.200	956.200	118	913.600	958.600
95	909.000	954.000	107	911.400	956.400	119	913.800	958.800
96	909.200	954.200	108	911.600	956.600	120	914.000	959.000
97	909.400	954.400	109	911.800	956.800	121	914.200	959.200
98	909.600	954.600	110	912.000	957.000	122	914.400	959.400
99	909.800	954.800	111	912.200	957.200	123	914.600	959.600
100	910.000	955.000	112	912.400	957.400	124	914.800	959.800
101	910.200	955.200	113	912.600	957.600			
102	910.400	955.400	114	912.800	957.800			

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
975	880.200	925.200	992	883.600	928.600	1009	887.000	932.000
976	880.400	925.400	993	883.800	928.800	1010	887.200	932.200
977	880.600	925.600	994	884.000	929.000	1011	887.400	932.400
978	880.800	925.800	995	884.200	929.200	1012	887.600	932.600
979	881.000	926.000	996	884.400	929.400	1013	887.800	932.800
980	881.200	926.200	997	884.600	929.600	1014	888.000	933.000
981	881.400	926.400	998	884.800	929.800	1015	888.200	933.200
982	881.600	926.600	999	885.000	930.000	1016	888.400	933.400
983	881.800	926.800	1000	885.200	930.200	1017	888.600	933.600
984	882.000	927.000	1001	885.400	930.400	1018	888.800	933.800
985	882.200	927.200	1002	885.600	930.600	1019	889.000	934.000
986	882.400	927.400	1003	885.800	930.800	1020	889.200	934.200
987	882.600	927.600	1004	886.000	931.000	1021	889.400	934.400
988	882.800	927.800	1005	886.200	931.200	1022	889.600	934.600
989	883.000	928.000	1006	886.400	931.400	1023	889.800	934.800
990	883.200	928.200	1007	886.600	931.600			
991	883.400	928.400	1008	886.800	931.800			

F-3. GSM-1900 ARFCN Frequencies (in MHz)

This subsection includes the following GSM-1900 ARFCN tables:

GSM-1900 A-Band ARFCN - Frequency (in MHz) Table F-1

GSM-1900 B-Band ARFCN - Frequency (in MHz) Table F-2

GSM-1900 C-Band ARFCN - Frequency (in MHz) Table F-3

GSM-1900 D-Band ARFCN - Frequency (in MHz) Table F-4

GSM-1900 E-Band ARFCN - Frequency (in MHz) Table F-5

GSM-1900 F-Band ARFCN - Frequency (in MHz) Table F-6

GSM-1900 A-Band ARFCN - Frequency (in MHz)

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
512	1850.2000	1930.2000	537	1855.2000	1935.2000	562	1860.2000	1940.2000
513	1850.4000	1930.4000	538	1855.4000	1935.4000	563	1860.4000	1940.4000
514	1850.6000	1930.6000	539	1855.6000	1935.6000	564	1860.6000	1940.6000
515	1850.8000	1930.8000	540	1855.8000	1935.8000	565	1860.8000	1940.8000
516	1851.0000	1931.0000	541	1856.0000	1936.0000	566	1861.0000	1941.0000
517	1851.2000	1931.2000	542	1856.2000	1936.2000	567	1861.2000	1941.2000
518	1851.4000	1931.4000	543	1856.4000	1936.4000	568	1861.4000	1941.4000
519	1851.6000	1931.6000	544	1856.6000	1936.6000	569	1861.6000	1941.6000
520	1851.8000	1931.8000	545	1856.8000	1936.8000	570	1861.8000	1941.8000
521	1852.0000	1932.0000	546	1857.0000	1937.0000	571	1862.0000	1942.0000
522	1852.2000	1932.2000	547	1857.2000	1937.2000	572	1862.2000	1942.2000
523	1852.4000	1932.4000	548	1857.4000	1937.4000	573	1862.4000	1942.4000
524	1852.6000	1932.6000	549	1857.6000	1937.6000	574	1862.6000	1942.6000
525	1852.8000	1932.8000	550	1857.8000	1937.8000	575	1862.8000	1942.8000
526	1853.0000	1933.0000	551	1858.0000	1938.0000	576	1863.0000	1943.0000
527	1853.2000	1933.2000	552	1858.2000	1938.2000	577	1863.2000	1943.2000
528	1853.4000	1933.4000	553	1858.4000	1938.4000	578	1863.4000	1943.4000
529	1853.6000	1933.6000	554	1858.6000	1938.6000	579	1863.6000	1943.6000
530	1853.8000	1933.8000	555	1858.8000	1938.8000	580	1863.8000	1943.8000
531	1854.0000	1934.0000	556	1859.0000	1939.0000	581	1864.0000	1944.0000
532	1854.2000	1934.2000	557	1859.2000	1939.2000	582	1864.2000	1944.2000
533	1854.4000	1934.4000	558	1859.4000	1939.4000	583	1864.4000	1944.4000
534	1854.6000	1934.6000	559	1859.6000	1939.6000	584	1864.6000	1944.6000
535	1854.8000	1934.8000	560	1859.8000	1939.8000	585	1864.8000	1944.8000
536	1855.0000	1935.0000	561	1860.0000	1940.0000	586	1865.0000	1945.0000

GSM-1900 D-Band ARFCN - Frequency (in MHz)

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
587	1865.2000	1945.2000	596	1867.0000	1947.0000	605	1868.8000	1948.8000
588	1865.4000	1945.4000	597	1867.2000	1947.2000	606	1869.0000	1949.0000
589	1865.6000	1945.6000	598	1867.4000	1947.4000	607	1869.2000	1949.2000
590	1865.8000	1945.8000	599	1867.6000	1947.6000	608	1869.4000	1949.4000
591	1866.0000	1946.0000	600	1867.8000	1947.8000	609	1869.6000	1949.6000
592	1866.2000	1946.2000	601	1868.0000	1948.0000	610	1869.8000	1949.8000
593	1866.4000	1946.4000	602	1868.2000	1948.2000	611	1870.0000	1950.0000
594	1866.6000	1946.6000	603	1868.4000	1948.4000			
595	1866.8000	1946.8000	604	1868.6000	1948.6000			

GSM-1900 B-Band ARFCN - Frequency (in MHz)

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
612	1870.2000	1950.2000	637	1875.2000	1955.2000	662	1880.2000	1960.2000
613	1870.4000	1950.4000	638	1875.4000	1955.4000	663	1880.4000	1960.4000
614	1870.6000	1950.6000	639	1875.6000	1955.6000	664	1880.6000	1960.6000
615	1870.8000	1950.8000	640	1875.8000	1955.8000	665	1880.8000	1960.8000
616	1871.0000	1951.0000	641	1876.0000	1956.0000	666	1881.0000	1961.0000
617	1871.2000	1951.2000	642	1876.2000	1956.2000	667	1881.2000	1961.2000
618	1871.4000	1951.4000	643	1876.4000	1956.4000	668	1881.4000	1961.4000
619	1871.6000	1951.6000	644	1876.6000	1956.6000	669	1881.6000	1961.6000
620	1871.8000	1951.8000	645	1876.8000	1956.8000	670	1881.8000	1961.8000
621	1872.0000	1952.0000	646	1877.0000	1957.0000	671	1882.0000	1962.0000
622	1872.2000	1952.2000	647	1877.2000	1957.2000	672	1882.2000	1962.2000
623	1872.4000	1952.4000	648	1877.4000	1957.4000	673	1882.4000	1962.4000
624	1872.6000	1952.6000	649	1877.6000	1957.6000	674	1882.6000	1962.6000
625	1872.8000	1952.8000	650	1877.8000	1957.8000	675	1882.8000	1962.8000
626	1873.0000	1953.0000	651	1878.0000	1958.0000	676	1883.0000	1963.0000
627	1873.2000	1953.2000	652	1878.2000	1958.2000	677	1883.2000	1963.2000
628	1873.4000	1953.4000	653	1878.4000	1958.4000	678	1883.4000	1963.4000
629	1873.6000	1953.6000	654	1878.6000	1958.6000	679	1883.6000	1963.6000
630	1873.8000	1953.8000	655	1878.8000	1958.8000	680	1883.8000	1963.8000
631	1874.0000	1954.0000	656	1879.0000	1959.0000	681	1884.0000	1964.0000
632	1874.2000	1954.2000	657	1879.2000	1959.2000	682	1884.2000	1964.2000
633	1874.4000	1954.4000	658	1879.4000	1959.4000	683	1884.4000	1964.4000
634	1874.6000	1954.6000	659	1879.6000	1959.6000	684	1884.6000	1964.6000
635	1874.8000	1954.8000	660	1879.8000	1959.8000	685	1884.8000	1964.8000
636	1875.0000	1955.0000	661	1880.0000	1960.0000	686	1885.0000	1965.0000

GSM-1900 E-Band ARFCN - Frequency (in MHz)

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
687	1885.2000	1965.2000	696	1887.0000	1967.0000	705	1888.8000	1968.8000
688	1885.4000	1965.4000	697	1887.2000	1967.2000	706	1889.0000	1969.0000
689	1885.6000	1965.6000	698	1887.4000	1967.4000	707	1889.2000	1969.2000
690	1885.8000	1965.8000	699	1887.6000	1967.6000	708	1889.4000	1969.4000
691	1886.0000	1966.0000	700	1887.8000	1967.8000	709	1889.6000	1969.6000
692	1886.2000	1966.2000	701	1888.0000	1968.0000	710	1889.8000	1969.8000
693	1886.4000	1966.4000	702	1888.2000	1968.2000	711	1890.0000	1970.0000
694	1886.6000	1966.6000	703	1888.4000	1968.4000			
695	1886.8000	1966.8000	704	1888.6000	1968.6000			

GSM-1900 F-Band ARFCN - Frequency (in MHz)

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
712	1890.2000	1970.2000	721	1892.0000	1972.0000	730	1893.8000	1973.8000
713	1890.4000	1970.4000	722	1892.2000	1972.2000	731	1894.0000	1974.0000
714	1890.6000	1970.6000	723	1892.4000	1972.4000	732	1894.2000	1974.2000
715	1890.8000	1970.8000	724	1892.6000	1972.6000	733	1894.4000	1974.4000
716	1891.0000	1971.0000	725	1892.8000	1972.8000	734	1894.6000	1974.6000
717	1891.2000	1971.2000	726	1893.0000	1973.0000	735	1894.8000	1974.8000
718	1891.4000	1971.4000	727	1893.2000	1973.2000	736	1895.0000	1975.0000
719	1891.6000	1971.6000	728	1893.4000	1973.4000			
720	1891.8000	1971.8000	729	1893.6000	1973.6000			

GSM-1900 C-Band ARFCN - Frequency (in MHz)

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
737	1895.2000	1975.2000	762	1900.2000	1980.2000	787	1905.2000	1985.2000
738	1895.4000	1975.4000	763	1900.4000	1980.4000	788	1905.4000	1985.4000
739	1895.6000	1975.6000	764	1900.6000	1980.6000	789	1905.6000	1985.6000
740	1895.8000	1975.8000	765	1900.8000	1980.8000	790	1905.8000	1985.8000
741	1896.0000	1976.0000	766	1901.0000	1981.0000	791	1906.0000	1986.0000
742	1896.2000	1976.2000	767	1901.2000	1981.2000	792	1906.2000	1986.2000
743	1896.4000	1976.4000	768	1901.4000	1981.4000	793	1906.4000	1986.4000
744	1896.6000	1976.6000	769	1901.6000	1981.6000	794	1906.6000	1986.6000
745	1896.8000	1976.8000	770	1901.8000	1981.8000	795	1906.8000	1986.8000
746	1897.0000	1977.0000	771	1902.0000	1982.0000	796	1907.0000	1987.0000
747	1897.2000	1977.2000	772	1902.2000	1982.2000	797	1907.2000	1987.2000
748	1897.4000	1977.4000	773	1902.4000	1982.4000	798	1907.4000	1987.4000
749	1897.6000	1977.6000	774	1902.6000	1982.6000	799	1907.6000	1987.6000
750	1897.8000	1977.8000	775	1902.8000	1982.8000	800	1907.8000	1987.8000
751	1898.0000	1978.0000	776	1903.0000	1983.0000	801	1908.0000	1988.0000
752	1898.2000	1978.2000	777	1903.2000	1983.2000	802	1908.2000	1988.2000
753	1898.4000	1978.4000	778	1903.4000	1983.4000	803	1908.4000	1988.4000

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
754	1898.6000	1978.6000	779	1903.6000	1983.6000	804	1908.6000	1988.6000
755	1898.8000	1978.8000	780	1903.8000	1983.8000	805	1908.8000	1988.8000
756	1899.0000	1979.0000	781	1904.0000	1984.0000	806	1909.0000	1989.0000
757	1899.2000	1979.2000	782	1904.2000	1984.2000	807	1909.2000	1989.2000
758	1899.4000	1979.4000	783	1904.4000	1984.4000	808	1909.4000	1989.4000
759	1899.6000	1979.6000	784	1904.6000	1984.6000	809	1909.6000	1989.6000
760	1899.8000	1979.8000	785	1904.8000	1984.8000	810	1909.8000	1989.8000
761	1900.0000	1980.0000	786	1905.0000	1985.0000			

F-4. GSM-1800 ARFCN Frequencies (in MHz)

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
512	1710.200	1805.200	552	1718.200	1813.200	592	1726.200	1821.200
513	1710.400	1805.400	553	1718.400	1813.400	593	1726.400	1821.400
514	1710.600	1805.600	554	1718.600	1813.600	594	1726.600	1821.600
515	1710.800	1805.800	555	1718.800	1813.800	595	1726.800	1821.800
516	1711.000	1806.000	556	1719.000	1814.000	596	1727.000	1822.000
517	1711.200	1806.200	557	1719.200	1814.200	597	1727.200	1822.200
518	1711.400	1806.400	558	1719.400	1814.400	598	1727.400	1822.400
519	1711.600	1806.600	559	1719.600	1814.600	599	1727.600	1822.600
520	1711.800	1806.800	560	1719.800	1814.800	600	1727.800	1822.800
521	1712.000	1807.000	561	1720.000	1815.000	601	1728.000	1823.000
522	1712.200	1807.200	562	1720.200	1815.200	602	1728.200	1823.200
523	1712.400	1807.400	563	1720.400	1815.400	603	1728.400	1823.400
524	1712.600	1807.600	564	1720.600	1815.600	604	1728.600	1823.600
525	1712.800	1807.800	565	1720.800	1815.800	605	1728.800	1823.800
526	1713.000	1808.000	566	1721.000	1816.000	606	1729.000	1824.000
527	1713.200	1808.200	567	1721.200	1816.200	607	1729.200	1824.200
528	1713.400	1808.400	568	1721.400	1816.400	608	1729.400	1824.400
529	1713.600	1808.600	569	1721.600	1816.600	609	1729.600	1824.600
530	1713.800	1808.800	570	1721.800	1816.800	610	1729.800	1824.800
531	1714.000	1809.000	571	1722.000	1817.000	611	1730.000	1825.000
532	1714.200	1809.200	572	1722.200	1817.200	612	1730.200	1825.200
533	1714.400	1809.400	573	1722.400	1817.400	613	1730.400	1825.400
534	1714.600	1809.600	574	1722.600	1817.600	614	1730.600	1825.600
535	1714.800	1809.800	575	1722.800	1817.800	615	1730.800	1825.800
536	1715.000	1810.000	576	1723.000	1818.000	616	1731.000	1826.000
537	1715.200	1810.200	577	1723.200	1818.200	617	1731.200	1826.200
538	1715.400	1810.400	578	1723.400	1818.400	618	1731.400	1826.400
539	1715.600	1810.600	579	1723.600	1818.600	619	1731.600	1826.600
540	1715.800	1810.800	580	1723.800	1818.800	620	1731.800	1826.800
541	1716.000	1811.000	581	1724.000	1819.000	621	1732.000	1827.000
542	1716.200	1811.200	582	1724.200	1819.200	622	1732.200	1827.200
543	1716.400	1811.400	583	1724.400	1819.400	623	1732.400	1827.400
544	1716.600	1811.600	584	1724.600	1819.600	624	1732.600	1827.600
545	1716.800	1811.800	585	1724.800	1819.800	625	1732.800	1827.800
546	1717.000	1812.000	586	1725.000	1820.000	626	1733.000	1828.000
547	1717.200	1812.200	587	1725.200	1820.200	627	1733.200	1828.200
548	1717.400	1812.400	588	1725.400	1820.400	628	1733.400	1828.400
549	1717.600	1812.600	589	1725.600	1820.600	629	1733.600	1828.600
550	1717.800	1812.800	590	1725.800	1820.800	630	1733.800	1828.800
551	1718.000	1813.000	591	1726.000	1821.000	631	1734.000	1829.000

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
632	1734.200	1829.200	675	1742.800	1837.800	718	1751.400	1846.400
633	1734.400	1829.400	676	1743.000	1838.000	719	1751.600	1846.600
634	1734.600	1829.600	677	1743.200	1838.200	720	1751.800	1846.800
635	1734.800	1829.800	678	1743.400	1838.400	721	1752.000	1847.000
636	1735.000	1830.000	679	1743.600	1838.600	722	1752.200	1847.200
637	1735.200	1830.200	680	1743.800	1838.800	723	1752.400	1847.400
638	1735.400	1830.400	681	1744.000	1839.000	724	1752.600	1847.600
639	1735.600	1830.600	682	1744.200	1839.200	725	1752.800	1847.800
640	1735.800	1830.800	683	1744.400	1839.400	726	1753.000	1848.000
641	1736.000	1831.000	684	1744.600	1839.600	727	1753.200	1848.200
642	1736.200	1831.200	685	1744.800	1839.800	728	1753.400	1848.400
643	1736.400	1831.400	686	1745.000	1840.000	729	1753.600	1848.600
644	1736.600	1831.600	687	1745.200	1840.200	730	1753.800	1848.800
645	1736.800	1831.800	688	1745.400	1840.400	731	1754.000	1849.000
646	1737.000	1832.000	689	1745.600	1840.600	732	1754.200	1849.200
647	1737.200	1832.200	690	1745.800	1840.800	733	1754.400	1849.400
648	1737.400	1832.400	691	1746.000	1841.000	734	1754.600	1849.600
649	1737.600	1832.600	692	1746.200	1841.200	735	1754.800	1849.800
650	1737.800	1832.800	693	1746.400	1841.400	736	1755.000	1850.000
651	1738.000	1833.000	694	1746.600	1841.600	737	1755.200	1850.200
652	1738.200	1833.200	695	1746.800	1841.800	738	1755.400	1850.400
653	1738.400	1833.400	696	1747.000	1842.000	739	1755.600	1850.600
654	1738.600	1833.600	697	1747.200	1842.200	740	1755.800	1850.800
655	1738.800	1833.800	698	1747.400	1842.400	741	1756.000	1851.000
656	1739.000	1834.000	699	1747.600	1842.600	742	1756.200	1851.200
657	1739.200	1834.200	700	1747.800	1842.800	743	1756.400	1851.400
658	1739.400	1834.400	701	1748.000	1843.000	744	1756.600	1851.600
659	1739.600	1834.600	702	1748.200	1843.200	745	1756.800	1851.800
660	1739.800	1834.800	703	1748.400	1843.400	746	1757.000	1852.000
661	1740.000	1835.000	704	1748.600	1843.600	747	1757.200	1852.200
662	1740.200	1835.200	705	1748.800	1843.800	748	1757.400	1852.400
663	1740.400	1835.400	706	1749.000	1844.000	749	1757.600	1852.600
664	1740.600	1835.600	707	1749.200	1844.200	750	1757.800	1852.800
665	1740.800	1835.800	708	1749.400	1844.400	751	1758.000	1853.000
666	1741.000	1836.000	709	1749.600	1844.600	752	1758.200	1853.200
667	1741.200	1836.200	710	1749.800	1844.800	753	1758.400	1853.400
668	1741.400	1836.400	711	1750.000	1845.000	754	1758.600	1853.600
669	1741.600	1836.600	712	1750.200	1845.200	755	1758.800	1853.800
670	1741.800	1836.800	713	1750.400	1845.400	756	1759.000	1854.000
671	1742.000	1837.000	714	1750.600	1845.600	757	1759.200	1854.200
672	1742.200	1837.200	715	1750.800	1845.800	758	1759.400	1854.400
673	1742.400	1837.400	716	1751.000	1846.000	759	1759.600	1854.600
674	1742.600	1837.600	717	1751.200	1846.200	760	1759.800	1854.800

ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK	ARFCN	UPLINK	DOWNLINK
761	1760.000	1855.000	802	1768.200	1863.200	844	1776.600	1871.600
762	1760.200	1855.200	803	1768.400	1863.400	845	1776.800	1871.800
763	1760.400	1855.400	804	1768.600	1863.600	846	1777.000	1872.000
764	1760.600	1855.600	805	1768.800	1863.800	847	1777.200	1872.200
765	1760.800	1855.800	806	1769.000	1864.000	848	1777.400	1872.400
766	1761.000	1856.000	807	1769.200	1864.200	849	1777.600	1872.600
767	1761.200	1856.200	808	1769.400	1864.400	850	1777.800	1872.800
768	1761.400	1856.400	809	1769.600	1864.600	851	1778.000	1873.000
769	1761.600	1856.600	810	1769.800	1864.800	852	1778.200	1873.200
770	1761.800	1856.800	811	1770.000	1865.000	853	1778.400	1873.400
771	1762.000	1857.000	812	1770.200	1865.200	854	1778.600	1873.600
772	1762.200	1857.200	813	1770.400	1865.400	855	1778.800	1873.800
773	1762.400	1857.400	814	1770.600	1865.600	856	1779.000	1874.000
774	1762.600	1857.600	815	1770.800	1865.800	857	1779.200	1874.200
775	1762.800	1857.800	816	1771.000	1866.000	858	1779.400	1874.400
776	1763.000	1858.000	817	1771.200	1866.200	859	1779.600	1874.600
777	1763.200	1858.200	818	1771.400	1866.400	860	1779.800	1874.800
778	1763.400	1858.400	819	1771.600	1866.600	861	1780.000	1875.000
779	1763.600	1858.600	820	1771.800	1866.800	862	1780.200	1875.200
780	1763.800	1858.800	821	1772.000	1867.000	863	1780.400	1875.400
781	1764.000	1859.000	822	1772.200	1867.200	864	1780.600	1875.600
782	1764.200	1859.200	823	1772.400	1867.400	865	1780.800	1875.800
783	1764.400	1859.400	824	1772.600	1867.600	866	1781.000	1876.000
784	1764.600	1859.600	825	1772.800	1867.800	867	1781.200	1876.200
785	1764.800	1859.800	826	1773.000	1868.000	868	1781.400	1876.400
786	1765.000	1860.000	827	1773.200	1868.200	869	1781.600	1876.600
787	1765.200	1860.200	828	1773.400	1868.400	870	1781.800	1876.800
788	1765.400	1860.400	829	1773.600	1868.600	871	1782.000	1877.000
789	1765.600	1860.600	830	1773.800	1868.800	872	1782.200	1877.200
790	1765.800	1860.800	831	1774.000	1869.000	873	1782.400	1877.400
791	1766.000	1861.000	832	1774.200	1869.200	874	1782.600	1877.600
792	1766.200	1861.200	833	1774.400	1869.400	875	1782.800	1877.800
793	1766.400	1861.400	834	1774.600	1869.600	876	1783.000	1878.000
794	1766.600	1861.600	835	1774.800	1869.800	877	1783.200	1878.200
795	1766.800	1861.800	836	1775.000	1870.000	878	1783.400	1878.400
796	1767.000	1862.000	837	1775.200	1870.200	879	1783.600	1878.600
797	1767.200	1862.200	838	1775.400	1870.400	880	1783.800	1878.800
798	1767.400	1862.400	839	1775.600	1871.600	881	1784.000	1879.000
799	1767.600	1862.600	840	1775.800	1871.800	882	1784.200	1879.200
800	1767.800	1862.800	841	1776.000	1871.000	883	1784.400	1879.400
801	1768.000	1863.000	842	1776.200	1871.200	884	1784.600	1879.600
			843	1776.400	1871.400	885	1784.800	1879.800

NOTES: